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SELECTION OF SCIENTIFIC WORKERS

A CHARACTERISTIC of the present age of the machine is the increasing use which is made in industry and elsewhere of the services of men and women with scientific or technical qualifications. This tendency was sufficiently apparent in peace-time, and the outbreak of war has intensified the demand. The active competition between the fighting services and industry for trained workers has already given cause for anxiety, which is reflected in the recent 'calling up' regulations referring to the 'reservation' of students of science and technology at school or university.

While it is generally agreed that a certain standard of training is essential for those who wish to take up a scientific or technical career, there is not so much known about the actual conditions under which scientific men in industry carry out their work, or of the personal qualifications which are desirable. Dr. Charles S. Myers, who is honorary scientific adviser to the National Institute of Industrial Psychology, has discussed some psychological aspects of these problems in *Occupational Psychology* (**15**, No. 1, 26 ; 1941).

The term 'scientific worker' is often used somewhat vaguely and it would be difficult to give any definition that would be considered adequate. In general, Dr. Myers refers to the professional scientific worker on the staff of an industrial or commercial organization, or of a Government department. He classifies such workers into three main groups : (1) The laboratory worker engaged in creating or trying out new ideas for the manufacture of a new or cheaper product. (2) The routine worker engaged in routine tests for the examination either of raw materials or of articles during or after their manufacture. (3) The 'service' worker engaged within the factory (as distinct from the laboratory) in solving the minor manufacturing problems of day-to-day occurrence.

Such differences in the work and in the environment of the work demand different mental abilities and different traits of temperament and character. The first group will be drawn chiefly from graduates in science with an honours degree and post-graduate training in research. No one could reach this standard without a high level of intelligence. These qualifications, however, do not ensure the possession of great inventive capacity or powers of imagination, without which the greatest discoveries are impossible. Although this type of work is in some aspects indistinguishable from that of an academic laboratory worker, yet the atmosphere in which the work is carried on is very different. Security of tenure as known to the academic worker does not exist ; in large organizations there may be virtual security, but that security depends on the continued success of the firm.

The industrial research worker has to face the fact that his firm must make profits even though he may have little share in them, and in some organizations there is a more blatant insistence on the profit-making than is either necessary or profitable. His work, too, will probably have to be kept secret to the firm, so that he has less chance of obtaining the personal prestige possible to his academic colleagues through the publication of researches. Hence the man who wants to work with a background of economic security and freedom to pursue his own path may find difficulty in adjusting himself to the industrial environment.

Such being the case, we have the somewhat anomalous position that the industrial research worker needs to be more academic than worldly in

outlook, temperamentally more introvert than extrovert. There is some truth in the statement that academic training has insufficient reference or resemblance to working conditions in industry or commerce. The methods therefore learnt in the university should be supplemented by a training in the different methods, techniques and environmental conditions.

Industry, on the other hand, has not always realized what it demands, and has overlooked the fact that the very qualities being sought need for development a different general environment from that of the factory proper.

The selection of the research director is very important. His qualities were discussed in NATURE of January 20, 1940, p. 81. More is required of him than ability to do research work. So far as his staff is concerned, he must be able to manage his subordinates, recognize genius and talent when he sees them, must never claim as his own without acknowledgment the ideas of others, and he must be in easy contact with his staff, not limiting his contacts to adverse criticism; in short, he must be scientific in regard to himself and to his environment as well as to his investigations—a much more difficult problem.

With advancing years originality tends to decrease. What then is the future of the scientific research worker? One suggestion is that he should have opportunities of learning other aspects of the industry, namely, those requiring the qualities of the older rather than of the younger worker. The research department should not be isolated from the other departments. His scientific training may prove invaluable in fields other than the laboratory. The problem ought also to be faced of whether research laboratory work can be a satisfying life-work for all those who enter it.

The routine scientific workers are recruited from boys who have not had a university education, and for this work high intelligence and creative ability are not necessary. Although routine work is not considered boring by all workers, yet investigation has shown that the more intelligent workers tend to experience a greater degree of boredom than others. There are some people who voluntarily earn their living by work that makes no demands on their intelligence, because they want their minds to be fresh for creative work outside office hours; but they are exceptions.

Temperamentally, the routine worker should be steady, placid and patient, able to find something of interest in routine work if only because to-day is another day. He should be able to detach his mind from work which is purely repetitive, and think of other things. The same problems of repetitive work that have been studied in the factory and office will be found relevant to routine scientific work. This means that the ambitious, keen, erratic boys with high intelligence are well-advised not to take up this work, unless it is specifically a stepping-stone to other work. In any group of these workers, however, there will be found some who are capable of more independent work. These should be allowed opportunities for further education.

Some scientific workers prove better at implementing than obtaining the results of research. They may, while being of a scientific attitude of mind and qualified in science, be more interested in the world and people outside themselves. That is, they prefer the works to the laboratory, so they are rather 'works scientists' under a works manager than 'scientific workers' under the research manager. Since the day-to-day problems brought to such a worker may be very varied, he needs as a basic qualification an honours degree, useful sometimes negatively in giving him information about what is not known as well as positively about what is known. On leaving the university or in the vacations he should have had first-hand experience of an industrial works, since his work will have to be done in collaboration with foremen and practical workers. He must therefore be able to understand the difficulties and explain the solutions when found. He will thus need a more outstanding personality than the laboratory worker.

Such in outline being the general situation, Dr. Myers asks whether the industrial psychologist can do anything to help. He makes three suggestions. In the first place, there should be a systematic study by trained people of the requirements of the various branches of research work, and tests devised, where they are not already in existence, to be used as a help in selection. Dr. Myers quotes an investigation which showed that a group of workers, who were recruited from about the same educational level as the routine scientific workers, required for their work considerable foresight, sustained 'distributed' attention, manipulative ability, intelligence, mechanical ability, judgment of time and colour, etc., while temperamentally they had to be tested for thoroughness, reliability and self-confidence among other desirable qualities. Some of these can be measured with

considerable reliability by objective tests; others can only be assessed as the result of an interview. Directors of research, like directors and managers in other parts of the organization, usually believe that they can choose staff by some magic gift peculiar to themselves, but unfortunately for the belief, misfits are not uncommon.

A study of the best methods of training beginners is important. It is odd that while the utmost care is taken in the training of beginners for sports, industry has been slow to apply the same principles, and entrants are expected to pick up their work by helping or watching proficients. Investigation has shown that a higher degree of efficiency can be attained by scientific training methods. It is possible that the same will be found true in the case of the laboratory workers. 'Trial and error' methods are extremely wasteful.

Lastly, a systematic study of grievances might lead to considerable improvement. The presence of a major grievance is an expensive luxury for any management. It is true that there are always with us the congenital grousers, but these can easily be recognized and are rarely taken seriously; but a legitimate grievance ignored by those who could remedy it is a danger point. From preliminary observations, excessive hours under strain or friction, inadequate holidays, fear of dismissal, and too great rigidity of organization are major grievances. Where the grievances result from a lack of understanding on the part of the workers, a reasoned explanation can do much to restore contentment; where the cause of grievances can be remedied it should be. Other industrial employees have benefited from a scientific study of their grievances, and there is no reason to suppose that scientific workers would be exceptional in this respect. The word 'scientific' has perhaps tended to isolate these workers from others; but all those who exchange the work of their hands or heads for the wherewithal to live have much in common, whatever may be the nature of the work.

THE BEHAVIOUR OF THE CUCKOO

The Truth about the Cuckoo
By Edgar P. Chance. Pp. xvi+208+38 plates. (London: Country Life, Ltd.; New York: Charles Scribner's Sons, 1940.) 12*s.* 6*d.* net.

MR. EDGAR CHANCE has produced a book which will be of interest not merely to those who watch and study birds and derive profit and pleasure from so doing, but also to the avian physiologist who concerns himself with the functions of the living parts of the bird and attempts to compare and correlate the processes which go on in them. This second book is fuller and more definite than the author's earlier one, entitled "The Cuckoo's Secret", and conclusions which were originally put forward as tentative or partly true are now regarded as established. No one who reads these books can fail to admire the industry, the patient deliberation and the ingenuity shown by the author in conducting his investigations, which have extended over more than twenty years.

The principal problem which Mr. Chance set himself to solve was whether the cuckoo laid its egg and then carried it in its beak (or in its gullet) before depositing it in another's bird's nest, or whether it laid it directly into the nest of the foster parent. The records given here conclusively prove that the latter is the actual method, and that even in the case of domed nests with small entrance holes the egg is projected right into the nest, the bill playing no part in the process.

There are other cuckoo problems dealt with by the author, and one of the most discussed of these relates to the observation that speaking generally each bird tends to parasitize a particular species of fosterer, there being a general likeness between the eggs of the parasitizing cuckoo and those of the fosterer. It is noted, however, that there are exceptions and some of these are described by the author. Prof. Punnett, in an instructive appendix on the genetical aspect of the cuckoo, urges that the collector should pay more attention to these exceptional eggs, and shows how it might be possible, by acquiring data on this and other matters capable of investigation in the field, to obtain a closer insight into the genetics of the species. Prof. Punnett is inclined to assume that the cuckoo is polyandrous; but Mr. Chance from his own observations is of the opinion that the bird very usually pairs for life. There is nothing unlikely about this (though Dr. Chapin, who contributes a foreword, thinks differently). For it

is undoubtedly true that numerous birds pair for life or until one of the partners dies, and Hudson states that even with a gregarious species like the starling there is evidence that the birds remain mated over a number of years.

Another matter of interest is the number of eggs which the cuckoo can lay, and Mr. Chance shows that a particular bird which was under observation for five seasons laid the world's record of twenty-five eggs in her fifth season. During the laying season it is usual for a cuckoo to lay every second day. It is obvious, as Mr. Chance remarks, that the fosterers' nests can be really suitable to receive an egg for only a few days, and this consideration led him "to formulate a theory that it is the cuckoo's habit first to seek out, by the process of watching its intended victims, the nests suitable for its eggs, and then to lay them on dates coinciding with those on which the nest is, or ought to be, in a favourable state", and the evidence acquired in subsequent seasons proves this theory to be right. Furthermore, Mr. Chance expresses the belief that there is probably a connexion between the watching of the future fosterer and the setting in motion of the cuckoo's egg-laying "machinery". If, however, the selected fosterer's nest be destroyed, the bird, after searching around, may lay its egg in an unusual nest or nest of a different species from the one in which it generally lays. This presumably only happens when the egg is already in the oviduct. We know that in many birds (though not in gallinaceous ones or in domestic ducks) ovulation, or discharge of the eggs from the ovaries, depends upon copulation, or at any rate upon a stimulus from the males, besides being further regulated by the number of the eggs in the nest, and that if the birds' nests are destroyed (in these cases their own nests) ovulation is held in abeyance. One would like to know whether similar considerations apply to the cuckoo. Some of the author's observations clearly suggest that they do. From what Mr. Chance has seen and recorded we have learned much. It is one of the merits of his book that it makes us wishful to know more.

I cannot conclude without congratulating Mr. Chance on the wonderful series of photographs which have contributed so largely to the successful solution of the problems investigated.

F. H. A. MARSHALL.

POWER UNITS FOR AIRCRAFT

Aircraft Engines

By A. W. Judge. Vol. 1. Pp. x+380. (London: Chapman and Hall, Ltd., 1940.) 16*s*. net.

THE possibilities of sustained flight at high speeds depend on the provision of power units of high output and light weight, the weight including the amount of fuel to be carried. The maximum power developed in a cylinder of given size is proportional to the maximum mean effective pressure which can be maintained in continuous running and the highest practicable speed of revolution, having regard to the increased weight of gearing for higher speed reduction. Economy of fuel consumption is demanded by the necessity for carrying a minimum weight of fuel for a given flight duration, in addition to reduction of weight of the necessary cooling accessories.

In this volume the author surveys the problems involved in attainment of maximum power per unit of capacity, high thermal efficiency, satisfactory carburation in all circumstances, effective cooling and maintenance of power at high altitudes. The consideration of engine types and mechanical details has been reserved for a later volume.

Although much of the information derived from research on automobile engines is of value in aircraft engine design also, the conditions of working differ in a number of respects. The automobile engine is a variable speed engine and works in an atmosphere of approximately constant density; on the other hand, aircraft engines run at approximately constant speed in atmospheres of greatly varying density. In both types, however, improvement of engine performance can only be attained by a study of the causes of loss of efficiency based on a knowledge of thermodynamic principles and of the results of the very considerable amount of research work carried out by a number of investigators. The author treats the problems involved in considerable detail, and their discussion is accompanied by diagrams and data summarizing results of experimental work carried out in recent years.

The text contains 113 references to published literature, the latest being dated January 1940, and the information contained in the publications referred to has been freely drawn upon. Many of these references are to N.A.C.A. reports and to the reports and memoranda of the Aeronautical Research Committee. For obvious reasons it has

not been possible to refer to more recent results of intensive research work which has contributed to the present remarkable performances of aircraft engines, but the author has made good use of the information available.

The style is clear and interesting, and in no portion of the book has a search for data on points of particular importance failed to produce reasonably adequate information accompanied by reference to the source of the data given. Such a search is facilitated by the satisfactory index which is provided. The diagrams are excellent and the publishers deserve a word of praise for the way in which the matter has been set out.

Only three misprints of minor importance have been noted. On p. 30, 'effecting' is used for 'affecting' and on p. 142, I.H.P. should read I.M.E.P. On p. 218 a wrong figure is referred to.

The volume can be recommended not only to students but also to engineers generally who are interested in improvement of aircraft engine performance. A. T. J. K.

PHYSICAL METHODS IN CHEMISTRY

Physical Chemistry

An Introduction. By Dr. E. A. Moelwyn-Hughes. Pp. viii+660. (Cambridge: At the University Press, 1940.) 45*s*. net.

ONE of the chief difficulties in writing a book on physical chemistry is to decide which parts of the subject are to be included. Dr. Moelwyn-Hughes has solved this difficulty by confining himself almost entirely to those topics which can be treated quantitatively in terms of molecular or quantum theory, omitting (among other things) the whole of the physical chemistry of solutions. The title "Physical Chemistry: an Introduction" is thus rather misleading, though the subjects treated form a coherent whole and provide an excellent demonstration of the power of modern physical methods.

The book is divided into two parts, the first of which deals with general facts and theories, while the second describes in detail applications to simple systems. Particular emphasis has been laid throughout on the appeal to experiment, and there are about a hundred and fifty tables of numerical data. In the theoretical sections the mathematical steps have been worked through in considerable detail with the object of making the book self-contained even for readers with little previous knowledge of mathematics. It has naturally proved impossible to adhere rigidly to this programme, but there are certainly very few places where it should be necessary to consult any other sources. This constitutes the most valuable feature of the book, since experience shows that the average chemical student learns mathematics much more painlessly when it is contained in a book not labelled "Mathematics". In the same way, the detailed accounts given of the standard results of quantum and statistical theory will doubtless prove more palatable to many now that they are included in a book entitled "Physical Chemistry".

Unfortunately, however, this care in detail is not matched by correctness and clarity in the description of fundamental concepts and principles. A few of the briefer mis-statements may be quoted. "The osmotic pressure may be regarded as the pressure exerted on the walls of the containing vessel by the solute only" (p. 7). "Temperature did not appear in Coulomb's law for the interaction of ions or the Drude-Voigt law for the refraction of light. The omission is justified because the electrostatic energy in both cases so greatly exceeds the kinetic energy due to heat that the latter can be ignored" (p. 111). "The impossibility of determining the [de Broglie] wave-length associated with protons and still heavier particles is an obvious one" (p. 168). "The maximum valency of any element is seven" (p. 226). ". . . the refraction figures refer to light of infinite wave-length, that is to an externally applied field of zero strength" (p. 436). "Activated complexes usually contain an odd number of electrons" (p. 562).

The more serious faults are less quotable. In the chapter on thermodynamics many of the relations given without qualification are actually applicable only to isothermal processes. A section is devoted to deriving the entropy of mixing of *two samples of the same gas at constant pressure*, though the author remarks that the final expression obtained is "merely a formal definition"! The introduction to the Maxwell-Boltzmann law seems likely to confuse any except the most clear-headed, largely through an indiscriminate use of the word "state". The derivation of the Clausius-Mosotti law is incorrect, and the correct expression is only obtained by replacing 3 by $D + 2$. Phrases like "it is clear" frequently introduce a statement which needs careful explanation; for example, "It is clear that the work done by the system when expanding reversibly is a maximum" (p. 288);

"A little reflexion will show that this temperature [the absolute zero] can never be realized experimentally" (p. 12).

It would be easy to comment at considerable length in this vein. The book can thus scarcely be recommended for the unsupervised study of physical chemistry, though the detailed account of what may be roughly described as 'chemical physics' will be of service to those who already have a thorough grounding in the principles of the subject. It will perform a useful service if it increases the number of physical chemists who have a working knowledge of (as opposed to a vague acquaintance with) the application of modern physical methods to chemical problems.

The book is produced in the usual meticulous style of the Cambridge University Press, and only a small number of misprints has been noted.

R. P. BELL.

ADVANCED ZOOLOGY

The Invertebrates

Protozoa through Ctenophora. By Libbie Henrietta Hyman. (McGraw-Hill Publications in the Zoological Sciences.) Pp. xii+728. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 46*s*.

THE present volume is an attempt to fill what has long been recognized as a very definite gap in text-books of zoology in English. In the preface the author states that her intention was to treat of the invertebrates in three volumes of which the first was to include the non-cœlomate forms. However, she found it impossible to compress all the matter selected into one volume of reasonable size and so decided to issue it in two parts of which this is the first. Those who use the book, and we are sure they will be many, will agree with the author in this. The treatise is obviously intended for students reading for an honours degree in zoology, for senior workers, and will moreover prove of considerable assistance to lecturers in groups other than their own, for it contains a remarkable amount of information. The nearest approach to it in English is Lankester's "Treatise on Zoology" which was never finished and is no longer up to date in many respects. The only other text-book with which it can be compared is Kükenthal and Krumbach's "Handbuch der Zoologie" and this is not in English, also unfinished and is on a much more pretentious and detailed scale. It has one advantage over both these works, in that it is by one author and therefore presents a balance and uniformity not attainable when a number of different authors are involved.

The eight chapters deal with: (1) Protoplasm, the cell and the organism; (2) Classification; (3) The acellular animals, phylum Protozoa; (4) Phylum Mesozoa; (5) Introduction to the lower Metazoa; (6) Metazoa of the cellular grade of construction—phylum Porifera; (7) Metazoa of the tissue grade of construction—the radiate phyla—phylum Cnidaria; and (8) The radiate phyla—phylum Ctenophora.

The book presents three outstanding features. The first is the judicious blending of morphology and physiology and systematics and phylogenetic speculation. The second is the remarkably well-chosen and up-to-date bibliography at the end of each chapter. That on the Protozoa, for example, occupies 24½ pages, is arranged under a number of different headings, and includes references almost up to the date of publication. Last, and by no means least, the illustrations call for special commendation. To say there are 221 figures is misleading, for most of the figures are in fact full-page plates each containing many drawings. With the exception of one or two photographs, all the illustrations have been drawn for the book and the great majority are original. There is thus a uniformity and originality in the illustrating that is a welcome relief from many text-books.

The book is well and clearly written and is remarkably free from errors or slips, although we wonder whether Smith minor would pass, Latin *ferro* to bear; and the reviewer does not like the title. The author states that whether or not she proceeds with the publication of the treatise, on the remainder of which a great deal of work has been done, will depend on the reception accorded the present part. It is to be hoped that the present disturbed conditions will not interfere so seriously with the sales that the project will not be completed. The amount of work involved in writing this volume must have been enormous, and the author has put all English-speaking zoologists in her debt by providing a book that no zoological laboratory and few advanced workers can afford to be without. The publishers, too, deserve credit for the manner in which the volume is printed and produced. Congratulations are due to all concerned for a most useful and noteworthy addition to zoological text-books.

THE UNIVERSITY OF LEYDEN

CONTRIBUTIONS TO BIOLOGY AND MEDICINE

BY PROF. F. J. COLE, F.R.S.

WHEN the charter of the University of Leyden was granted on January 6, 1575, the indomitable Dutch people were engaged in a struggle against the Spaniards for their independence. Thirty-five long years of war and desolation were still to run before that end was achieved, but the University, from the date of its foundation, never closed its doors until these latter days of enlightenment, when the heroic Dutch nation is again fighting to preserve the most elementary rights of mankind.

An Englishman visiting the modern University of Leyden is captivated by the formal old-world courtesy with which he is received. Here at all events is to be found a deep reverence for learning —a university where the professor is approached with what seems to us unusual and even embarrassing respect. Leyden is the complete academic city, and it is appropriate that its University should be the oldest and most famous in the Dutch Empire. The city itself has played a great part in the development of Dutch art, and a list of the illustrious painters born within its walls would include Rembrandt, the greatest of all, Gabriel Metsu, the brothers van de Velde, the Mieris' father and sons, that meticulous and delightful craftsman Gerard Dou, and the jovial tavern keeper Jan Steen, from whose paintings alone it would be possible to compile a work on the manners and customs of the Dutch people of the period.

Leyden also demands attention as an important academic publishing centre, and "Lugdunum Batavorum" is one of the most familiar imprints of the seventeenth and eighteenth century scientific works. Here the Elzevir family of Dutch printers set up their presses and produced their first book in 1583, becoming in due course printers to the University. The impressive folio of Worm's "Museum" (1665) is an Elzevir production, and other famous biological works printed in Leyden are the "Biblia Naturæ" of Swammerdam (1737–38), the "Opera Omnia" of Malpighi (1687) and the beautiful edition of the works of Vesalius edited by Boerhaave and Albinus in 1725.

In the seventeenth century, Leyden was at the height of its fame, and was a serious rival even of Paris and Padua. It was a Protestant seat of learning, and practised the widest religious tolerance, being almost the only university of the period pre-eminent in science and letters which did so. No university had professors of equal learning and personality, nor could they be tempted away from Leyden by offers of more imposing chairs in other academic centres. The University had been provided by the State with a liberal endowment, and was organized in five faculties, of which law and medicine were the best known. At first the curators favoured the theological faculty, and after that, law, medicine and history. Languages, apart from Greek, and science were somewhat less privileged. The neglect of philosophy is only an expression of the anti-scholastic bias of the University. The Leyden school of law enjoyed and deserved a great reputation, and at one time half the students in the University were studying law. The nobility of the Scottish bar owed its training to Leyden and Utrecht. Walter Scott makes one of his characters lament that he had not studied law in Holland, and that his father had lacked the sense to send him to Leyden.

Early in the seventeenth century there were six hundred students in the University. The professors of the science faculty from the first introduced a leaven of practical work into their instruction—an innovation which was perhaps a shrewd expression of their opinion of scholastic learning. In science and medicine Leyden was far in advance of ancient British universities. An Englishman who had studied and graduated at Leyden in 1737 set up as a free lance in Oxford, lecturing on anatomy, chemistry and medicine, because, as he said, "no one else was anxious to undertake the task". This stimulated the University to appoint a reader in chemistry and to import an anatomy lecturer from London.

From its foundation Leyden broke with the medieval tradition, and its attitude towards teaching and research was more in accord with modern practice, the professors concentrating rather on the training of scholars than on the fashioning of gentlemen. The students were under no tutorial supervision, and they lived, dressed, and to a large extent behaved, as they pleased. Travellers from England noted the marked contrast which such a system offered to their own Universities of Oxford and Cambridge, although somewhat paralleled by the universities of Scotland.

The buildings of the young University are known from contemporary engravings. In 1614 four faculties were housed in a small but pleasing

structure which included a library, anatomy theatre, class rooms, and a hall in which the portraits of professors were displayed. There were then twelve ordinary professors, and subordinate instructors. A century later this building had been extended by the addition of two bays and a tower, but was still of modest dimensions. The library in 1610 included rather less than a thousand chained books, in which there was a preponderance of theology and law, and a lesser representation of history, letters, philosophy, medicine and mathematics, a special case being devoted to the works of the revered Scaliger. Readers were condemned to stand when consulting the books. By 1716 a rich collection of Oriental manuscripts had been acquired, and about one third of the library was now theological. History and letters came next, but law, mathematics, 'philosophy' and medicine had dropped behind. The old cases and the chains had gone, and cases of a modern pattern been installed, grilles protecting the more valuable books. The existing library contains more than 6,000 Oriental and other manuscripts and about 850,000 books.

The famous old anatomy theatre at Leyden was several times engraved, and also painted by Buytenwegh, the earliest print bearing the date of 1610. The design may be compared with that adopted by Fabricius at Padua, T. Bartholin at Copenhagen, and Rudbeck at Uppsala. The students were accommodated on five rising concentric platforms, and, as usual in these ancient small anatomy theatres, no seats were provided. On the floor was an oval table for the body, and the professor himself conducted the dissection. The theatre was also a museum, and included a large case of early dissecting instruments such as are figured in the "Fabrica" of Vesalius. In most of the engravings the theatre is occupied by human skeletons and lay figures—one of the former smoking a pipe. Borrichius was greatly pleased with the theatre when he saw it in 1663, and there are several descriptions of the anatomy museum dating from 1697. In 1610 the collection was small and of no scientific pretensions, but by the end of the sixteenth century it had developed into one of the most valuable and best equipped in Europe. Evelyn saw it in 1641, and was deeply impressed by the series of skeletons which were displayed.

The Botanic Garden, founded in 1587, is also known from various prints. The Hortus Medicus as figured in 1614 must have been a charming formal garden, and changed very little in its first century of existence, except for the addition of more houses. At the end of the seventeenth century it was one of the most completely organized in Europe, and it was this garden that aroused in Haller a passion for botany. It may here be pointed out that the State Museum of Natural History is located at Leyden, and an important modern development is the History of Science Museum—one of the few representatives of its class—which houses a magnificent collection of manuscripts and instruments associated with the discoveries of Huygens, Swammerdam, Leeuwenhoek and other scientific workers.

The early professors and alumni of the University of Leyden include at least six names of universal acclaim. J. J. Scaliger (1540–1609), "the bottomless pit of erudition", went to Leyden as professor in 1593, on terms which only a great man could dictate, but the University gladly conceded every demand since it "wished only for his presence". He was one of the greatest classicists of modern times, and the founder of the method of historical criticism. His treatise on the astronomy of the ancients and its relation to Copernican science is the work of a great mind. There is an interesting description of this literary sultan dispensing judgments from this throne in Leyden which were dutifully accepted by the learned as Holy Writ.

Hugo Grotius (1583–1645), the international jurist, and one of the three big men of Delft, was a graduate in law of Leyden. His father had been burgomaster of the city and was one of the curators of the University. It was said of Grotius that he was "the greatest of Hollanders and one of the ornaments of his age". Swammerdam (1637–1680), who graduated M.D. Leyden in 1667, will ever be remembered as the author of the "Biblia Naturæ"[1]. Boerhaave (1668–1738), M.D. Leyden 1693, occupied at times the chairs of medicine, botany, practice of physic and chemistry, and was twice elected rector of the University[2]. He was the leading physician and iatro-chemist of his age—the "Batavian Hippocrates", and a very great personality. His success as a teacher was such that the ablest of the younger men were attracted to the school of which he was the head.

Lyonet (1706–1789), whose treatise on the larva of the goat moth is the finest and most beautiful example of micro-dissection in existence, entered as a theological student at Leyden to please his father, but later went over to law, in which faculty he took his doctor's degree in 1731. It is not known to what extent the University influenced his work as a naturalist.

Haller (1708–1777) received his medical degree from the hands of his teacher Boerhaave in 1726. He also worked with Albinus and Ruysch during his stay at Leyden. His fame was universal, and no person of eminence and rank visited the town in which he lived without paying their respects to him. He was at various times an anatomist, physiologist, botanist, physician, philosopher, historian, bibliographer, poet and novelist. It is sur-

prising that so versatile a man should ever have admitted the existence of limitations. Nevertheless he came to distrust his powers as a poet. At the age of fifteen he had produced an epic poem of four thousand verses in the Virgilian idiom. This composition so pleased him that he rescued it at the peril of his life when the house in which he was living was destroyed by fire. Yet, to quote Vicq d'Azyr, one year sufficed to dissipate his satisfaction, and he committed the poem to the same destructive element from which he had saved it. Haller's incomparable bibliographical works involved the consultation of 52,000 books and memoirs, and his own library, probably the most complete of its kind ever assembled by a private individual, numbered more than 20,000 volumes. He is said to have written 13,000 papers. Leyden, Oxford and other universities were anxious to secure his services; but in spite of tempting proposals he declined all such invitations.

Apart from these six outstanding figures there are still a number of biologists, only less distinguished, whose debt to the University of Leyden was direct and considerable. Dodoens (1517–1585), the medical botanist and author of a famous Herbal, collaborated with Christopher Plantin, the renowned printer of Antwerp, in the production of scientific works. Clusius (1526–1609), also a herbalist, added 600 species to the flora, and was one of the first to introduce the potato into Europe. Bontius (1598–1631), a member of a Leyden family, was a pioneer of the study of tropical medicine, and the first to describe beriberi and tropical dysentery. Jonston (1603–1675), of Scots descent and a Leyden M.D., was a voluminous writer on natural history, whose works passed through many editions and translations and enjoyed a considerable vogue up to the time of Linnæus. Piso (1611–1678), born in Leyden and an M.D. of the University, wrote on the natural history of Brazil and was a student of tropical medicine, being the first to describe yaws.

Blasius (? –1692) produced one of the earliest comprehensive treatises on comparative anatomy (1681), and founded an important medico-anatomical society in Amsterdam in 1664. Drelincourt (1633–1697) was the teacher of Boerhaave and wrote on anatomy and generation. Ruysch (1638–1731), the most celebrated anatomical preparateur of his time, obtained a mastery over injection methods which astonished his contemporaries and successors. Kerckring (1640–1693) was a notable anatomist whose views on generation aroused considerable interest and controversy. Bidloo (1649–1713) produced a magnificent work on human anatomy. Breynius (1680–1764) investigated the flora of Holland, Italy, France and Spain. 's Gravesande (1688–1742), professor of mathematics, physics, astronomy and philosophy, developed the physical aspects of physiology. B. S. Albinus (1697–1770), who occupied the chair of anatomy at Leyden for nearly fifty years, raised anatomy to the level of a scholarly study distinguished by the accuracy, artistic beauty and literary style of its published results. His contemporaries regarded him as the leading anatomist of his age. Baster (1711–1775), one of the earliest pupils of Albinus, was a pioneer of marine biology, and explored the structure and life-history of marine animals and plants. Lieberkuhn (1711–1756), a pupil of Boerhaave and Albinus, became famous for his micro-injections of the wall of the gut. Camper (1722–1789), a native of Leyden and a great comparative anatomist, applied metric methods to the study of anthropology, being responsible for the introduction of the 'facial angle' as a criterion of race. An artist himself, he demonstrated the connexion between the science of anatomy and the arts of painting and sculpture. Gronovius (1730–1777), a senator and justice of Leyden, was a well-known systematic naturalist and bibliographer.

It is a remarkable tribute to the international character of the Royal Society of London and to its efforts to advance natural knowledge in lands other than its own, that thirteen of these distinguished members of the University of Leyden were elected fellows of the Society.

Our brief sketch barely touches the fringe of the labours and influence of this venerable academy, and it leaves out of account the activities in biology and medicine of the University in modern times. True to a tradition which goes right back to its foundation, the policy of Leyden has always been a progressive one. It moves not only abreast of the times, but also plays a great part in initiating and directing new developments. The closing of such an institution is an offence against the light, and a crude and blundering negation of the ancient rights of universities.

[1] For an account of his life and work see NATURE, **139**, 218 and 287 (1937).
[2] NATURE, **142**, 1013 (1938).

CONTRIBUTIONS TO PHYSICS AND CHEMISTRY

By Dr. L. C. JACKSON

Now once more Holland is in the grip of an enemy even more opposed to those ideals of freedom of conscience and of scientific inquiry than the one against whom the citizens of Leyden fought so bravely. The present professors and students of the University of Leyden, being men of independent spirit and worthy successors of their

forebears of 1575, it is not surprising that they have come into conflict with the Nazi authorities temporarily in power in their country. The suppression of the University has been the consequence, and once more "all instruction of youth in the sciences and liberal arts is likely to come into entire oblivion". This brief appreciation of one side of the University's work since its foundation may serve to express the regret which will be felt in all free and cultured countries at this further evidence of German barbarity.

Throughout its existence the University of Leyden has contributed notably towards the development of physical science. One may recall the names of Willebrord Snel (1591–1626), who discovered the law of the refraction of light and carried out the first geodetic measurements in Holland over an arc from Alkmaar to Bergen op Zoom; of Christiaan Huygens (1629–95), who was a student at Leyden and whose discoveries in optics and mechanics are too well known to need more than a passing reference; of P. van Musschenbroek (1692–1761), whose researches on static electricity gave us the Leyden jar; and of H. Boerhaave (1668–1738), who, though primarily concerned with medicine, included studies in the physical sciences among his many activities.

Coming to more modern times, the Leyden dissertation of J. D. van der Waals (1873), "On the Continuity of the Gaseous and Liquid States", was a milestone in the history of physics. His equation of state, his law of corresponding states, and his later work on the phase relationships of binary mixtures, initiated a stream of research which has contributed enormously to our knowledge and is still being actively pursued.

When H. Kamerlingh Onnes was appointed to the chair of physics at Leyden in 1882, he set himself the task of collecting accurate data on the properties of liquefied gases to test the theoretical conclusion of van der Waals. This demanded extensive facilities for work at low temperatures and led step by step to the foundation of the famous Cryogenic Laboratory, where physical problems of all kinds can be investigated down to the lowest temperatures obtainable. Here was realized Onnes' dream of an international research laboratory, where workers of all nationalities were welcomed and provided with facilities for carrying out investigations in low temperature physics. It would be difficult to over-estimate the contribution of Kamerlingh Onnes to international goodwill and understanding among men of science by his infectious enthusiasm and generous hospitality, coupled as it was with his part in the foundation of the "Institut international du Froid". Ironically enough, the last meeting of the Institut took place at Karlsruhe and Baden-Baden in July 1939. The scientific work of Onnes and his collaborators ranged over all branches of low-temperature physics, and the hundreds of papers reprinted in the *Communications from the Physical Laboratory of the University of Leiden* are a permanent testimony to his skill and industry. Of Onnes' own achievements his liquefaction of helium, whereby temperatures in the neighbourhood of 1° K. became accessible, and his discovery of superconductivity, are perhaps the most notable.

W. H. Keesom and W. J. de Haas, co-directors of the Cryogenic Laboratory in succession to Onnes, have maintained the tradition of the high quality of scientific output and international hospitality. Keesom's work has mainly concerned the production of solid helium, the determination of specific heats at the lowest temperatures and the investigation of the thermal properties of superconductors, while that of de Haas has dealt with paramagnetism, the electrical and magnetic properties of superconductors and the production of temperatures below 1° K. by the method of adiabatic demagnetization.

It was at Leyden, too, that P. Zeeman discovered the effect of a magnetic field on the emission and absorption of light in 1896, and so provided an invaluable tool for the formal analysis of spectra and the investigation of atomic structure. An interpretation of this discovery was immediately furnished by H. A. Lorentz (1853–1928), then professor of theoretical physics at Leyden, in terms of the electron theory of matter with which his name will always be associated. Lorentz was one of the outstanding figures in theoretical physics in that transition period when the difficulties of classical theory were becoming more and more apparent, and were being overcome by the introduction of the ideas of the quantum theory. His brilliance as a physicist was only equalled by his excellence as a linguist, which, coupled with the charm of his personality, made him the ideal chairman of international gatherings. He contributed notably to work of this nature, being president of the Institut international de Physique Solvay and chairman of the Committee for Intellectual Cooperation of the League of Nations.

Lorentz's successor in the chair of theoretical physics was P. Ehrenfest. The latter's own publications were not very numerous, but were all of fundamental importance and characterized by the clarity with which the essential features of the problem were presented. It was, however, as a teacher and inspirer of younger men that Ehrenfest, with his restless enthusiasm and vivacious personality, will best be remembered. All who knew him regret his sad end and the clouding of his later years by the dismal fate of his native Austria, which he foresaw so clearly.

APPLICATION OF MODERN PHYSICS IN THE EXAMINATION OF PAINTINGS

By Dr. H. J. Plenderleith,
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THE application of physical methods of examination to paintings has proved in recent years a very fertile field of research yielding results of considerable importance to specialists and often of interest to the general public. Ever since X-rays were first trained upon a painting, it has been recognized that under-surface structures can be revealed which may well be of interest to the student; moreover, it is often possible to assess the condition of the groundwork of the picture and so obtain an indication of its stability.

It was discovered, thanks to the distribution of white lead in the underpainting and modelling, that the X-ray shadowgraph was not an indeterminate thing, but as often as not an approximate reproduction of the original picture with distorted tone values: the high lights appearing clear (as lead is relatively opaque to the rays) whereas the darker pigments were recorded in varying densities. One could scarcely fail to detect by this means the extreme case where more than one picture had been painted on the same panel or canvas; and it was sometimes possible to observe where an artist had modified his original sketch, provided that sufficient heavy pigment (flake white; vermilion) was present in the paint mixture.

The results obtained by using the ordinary medical type of X-ray equipment did not, however, always come up to expectations. For one thing the painting is usually a ponderous and unwieldy subject for study. It often has a heavy support (panel or reinforced canvas) and a laminated structure consisting of ground or priming upon which is the sketch and various paint layers with perhaps some superimposed layers of varnish. Resolution of the shadowgraph was often unsatisfactory and interpretation difficult.

The increased importance that has attended the application of X-rays to the study of paintings in recent times may be traced to Mr. Alan Burroughs[1], who, working at the Fogg Art Museum, began in 1925 a long-term research involving the study of paintings in Boston as well as in various European collections. He established that with due safeguards the rays are in no way harmful to paints or painting materials even after periods of irradiation very greatly in excess of what is required in the ordinary way. This eliminated certain misgivings that had existed, particularly among owners and curators, who are naturally nervous of having their charges damaged even by the most well-intentioned man of science. Mr. Burroughs' systematic work in examining paintings has done much to stimulate similar researches in European centres, where, indeed, important pioneer work had already been accomplished. As the field of inquiry developed on a broader front, a body of information became available which has given a fresh impetus to the critical study of painting.

When the National Gallery Laboratory was established in 1934, one of the first tasks undertaken by Mr. F. I. G. Rawlins, director, was to design apparatus which would allow of X-rays being applied with safety to all kinds of paintings regardless of size, so that maximum definition of the specialized structures would be obtained. This equipment has taken the form of a heavy metal easel designed to carry the painting in such a way that it can be very easily displaced and adjusted in one plane, and this is done by counter-weights and slides. The X-rays are applied from the back, at right angles to the picture, and a fluorescent screen may be slid into position in front at option. This apparatus has proved invaluable in several kinds of investigation where the painting is required to be held rigidly in a vertical position.

It was found in due course that the unsatisfactory definition of the developed X-ray film could often be accounted for by the comparatively high kilovoltages which it was usual to employ, and that this difficulty could be largely overcome and the method applied more generally and with greater prospect of success when the penetration was cut down to that corresponding to the order of 10–12 kv. or thereabouts.

A large number of satisfactory observations, sometimes from the most unpromising of subjects, has resulted from the recognition of the importance of using soft radiations, and the finer details of structure which can thus be revealed open up a new field in the study of the style and development of the old masters.

It is sometimes possible to go a step further along the path of perfection than the best X-ray shadowgraph obtainable when conditions are one single exposure at the chosen degree of penetration. This is done by making a series of shorter exposures at slightly varying kilovoltages and, other things being equal, the result may show improved gradation by reason of the film having been stimulated to the different potentials.

To all who are interested in the modern applica-

tion of X-rays to the study of paintings, a recent publication by the Trustees of the National Gallery will have a strong appeal. The book is entitled "From the National Gallery Laboratory"[2] and is devoted entirely to illustrations of well-known paintings placed side by side with their X-ray photographs, and there are occasional photographs made by infra-red radiations as well. The book has a preface by Sir William Bragg and an introduction and notes by Mr. Ian Rawlins, these last giving the essential information regarding kilovoltages and currents at which the X-ray work is carried out and a concise interpretation of the results. The X-ray photographs have been prepared from a new film printed from the original X-ray film, and in this way tones are reproduced relatively as in the original picture.

It is clear from the illustrations that infra-red photography has itself an important contribution to make, and it provides information of a different character from that obtained by X-rays or, indeed, by any other method of non-destructive examination. Infra-red photography is used in studying the immediate sub-surface of a painting, as the rays can penetrate a thin film of dust or ingrained dirt and even decayed varnish, and record pictorial details which are not visible in the ordinary way. The apparatus in use at the National Gallery Laboratory[3] is of original design, consisting of an all-metal camera of fixed focus, the inside of which is coated (by electro-deposition) with a matt layer of metallic cadmium in order to help to eliminate flare, the reflective power of this metal in such a state of aggregation being exceedingly low for infra-red rays. Focusing difficulties are overcome by using a Ross lens of dispersion such that parfocal images are obtained with visible and infra-red rays, thus admitting of the use of a ground glass screen. Special precautions are necessary with the plates, which must be fresh. They are kept under refrigeration until shortly before use, when they are gradually acclimatized to conditions in the studio, thus obviating complications which would result from the condensation of moisture.

Another profitable inquiry is the study of fluorescences obtained by ultra-violet illumination of the picture, and in this case the investigation is made by visual examination which may be supplemented by photography.

Most varnishes, dirt, grease, etc., have characteristic fluorescences, and these have to be recognized and discounted where possible. It may be necessary, however, to go a stage further and have a picture cleaned or even the varnish removed if full value is to be obtained from the investigation.

The most suitable type of apparatus for ultra-violet work is a high-pressure electronic discharge tube contained in a metal hood carrying a large dark filter which transmits freely the bands around 3660 A., but absorbs all visible rays. This is mounted on an adjustable stand which may conveniently have a daylight comparator attached, this being an essential adjunct where visual studies are concerned. Examination by ultra-violet light is of service, *inter alia*, in indicating the extent of repairs or repaints, and in revealing certain kinds of falsification (signatures and craquelure).

The connoisseur has long been accustomed to use lenses and binocular magnifiers in making surveys of his pictures, and much can be accomplished by such simple means by varying one's position and the angle of incidence of the light. Transverse or tangential illumination, for example, throws into relief any irregularities of surface which might result from 'make up' (stopping) or from a variation of brushwork. Polaroid screens for cutting down excess glare are a modern addition to his equipment, which, as long as shiny varnishes are in use, will doubtless be welcome. Microscopy at higher powers than about ×30, however, will remain a laboratory activity, and where, as at the National Gallery Laboratory, a travelling microscope is mounted for the scrutiny of surfaces by polarized light, a powerful means of studying brushwork is available. When the areas under study are too far apart to be collected in the same field by a comparison microscope or synchrisoscope, photomicrographs of chosen areas are very convenient for examination and comparison at leisure.

The measurement of colour, as, for example, by the tintometer, may be used to serve as a check on fading or on the effects of picture-cleaning on pigments; and it may be used in conjunction with microscopy to indicate when the time has come to renew yellowed varnish which has ceased to function as a protective coating and is distorting the colour values and composition. There are problems of identification which involve determination of refractive index. Spectrophotography and absorption spectrometry each have an important future in the study of medieval pigments.

The physicist of to-day has indeed much to offer to both art historian and curator, but to be of value the nature of the offer has to be appreciated, and this has only recently been realized in the art laboratory, where the atmosphere lends itself to sympathetic co-operation between all parties and a pooling of interests.

[1] Burroughs, Alan, "Art Criticisms from a Laboratory". London: George Allen and Unwin, Ltd. (1940).

[2] From the National Gallery. Pp. viii + 50 plates (London: National Gallery, 1940). 6s. net.

[3] Rawlins, F. I. G., *Museums J.*, **38**, 186 (1938), and *Cantor Lectures*, R. Soc. Arts (1937).

THE ACTIONS AND USES OF HEMP DRUGS

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THE use as an intoxicant of hemp resin, collected from the flowering tops and other parts of the plant, is of great antiquity. Cannabis was probably cultivated partly for this use three thousand years ago in China, and such cultivation has spread widely: to India, Persia, Greece, Arabia and Egypt; through Africa and the Americas, where "the situation [as regards addiction] is of the utmost gravity and is one which calls for drastic measures of eradication"[1].

The drug was introduced into Western medicine about a century ago, as an adjuvant in nervous headaches. In a very short time its value was claimed as established for a very heterogeneous series of complaints. We read that cannabis "gives relief from pain and increases the appetite in all cases, no matter on what causes the pain and loss of appetite may depend"[2]; that "for the relief of supraorbital neuralgia no article perhaps affords better prospects than cannabis"[3]. It was acclaimed for all uterine conditions: in menorrhagia and dysmenorrhœa, as an antispasmodic and also as an oxytocic. A common ingredient in corn paints, it was also believed for a time to be of value in the extraction of confessions from suspected criminals. Such varied uses were likely to lead to disappointments, and with the development of synthetic analgesics and hypnotics, cannabis fell further and further out of favour, and was "omitted" from the British Pharmacopœia in 1932, but was retained, against the advice of certain authorities, in the United States Pharmacopeia.

The actions produced by extracts in animals vary somewhat with the species used and the route of administration. In the dog, the striking symptoms are depression, swaying and ataxia. For assay purposes, six degrees of ataxia have been specified[4]. Doses of 5–10 mgm./kgm. of the dry extract produce their maximum effect when given by mouth in about an hour. About a tenth of this dose produces a shorter but more dramatic effect when dissolved in acetone and injected intravenously. The action following on subcutaneous administration is unreliable because of the uncertainty of absorption. When it does develop, it may last for days. In the cat, in addition to these symptoms, the corneal reflex is depressed or abolished, even with doses which scarcely affect other reflexes. This reaction is not seen in the dog, but is easily demonstrated after intravenous injection in the rabbit. With highly purified fractions, we have seen it with doses of less than 0·1 mgm./kgm. This remarkably selective response is known as the Gayer test[5]; it is probably specific, and has been made the basis of assay by many workers. Ataxia is less pronounced in the rabbit than in the dog, but by no means unknown. An animal which is well under the influence of the drug can be made to assume and will retain most unnatural attitudes. The lethal dose is about two hundred times the minimal dose which produces symptoms. The pharmacological action may be summarized as a rather selective central depression.

Similar depression is found in man, and accounts for the use of the drug as an analgesic and hypnotic. When ingested, the narcotic effects predominate. When smoked, Dixon[6] found the drug a satisfactory expedient in combating headache and exhaustion. Although medicinal cigarettes for such actions have been prepared, their use has never become popular, except with the addict, probably because of the difficulty of regulating the dose. Some of the difficulties of any such regulation may be briefly considered.

(1) Few drugs show such variations in their content of active material. Even the proportion which is alcohol-extractive may vary between eleven and twenty-six per cent[7]. The resin contains a number of closely related compounds, some of which (cannabinol, cannabol, cannabidiol) are entirely inactive. Todd has reviewed the chemical side of the subject in a recent paper in this journal[8].

(2) Individual variation in susceptibility is even more marked with hemp than with most drugs. At one time it was commonly claimed that the attractions of hashish were only experienced by Orientals, in spite of much evidence to the contrary. The growth of the addiction in the United States should put an end to this misapprehension, but the fact of profound variation is well established. In laboratory animals, too, there are enormous differences in susceptibility and resistance, so that isolated observations on one or two animals are of very limited significance.

(3) Even in the individual, there are remarkable variations in the response at different times: variations which cannot be attributed to the use

of dissimilar preparations or to any other known factor. This has long been recognized by addicts, and is accurately recorded by Ludlow[9]:

". . . I have taken at one time a pill of thirty grains, which hardly gave a perceptible phenomenon, and at another, when my dose had been but half that quantity, I have suffered the agonies of a martyr, or rejoiced in a perfect phrensy. So exceedingly variable are its results, that, long before I abandoned the indulgence, I took each successive bolus with the consciousness that I was daring an uncertainty as tremendous as the equipoise between hell and heaven. Yet the fascination employed Hope as its advocate, and won the suit."

(4) In ordering hemp drugs, the prescriber can scarcely overlook the possibilities of addiction. Actually, addiction has never been recorded as resulting from the medicinal use of this group, but the existence of addiction and the mere fact that the law in Great Britain has classed cannabis with cocaine and the opiates as "Dangerous Drugs" cannot but impress the cautious practitioner.

In the light of these difficulties, the question may well be asked, "Why then bother about cannabis in therapeutics?" Both clinician and pharmacologist may attempt an answer.

In the clinical experience of many alienists, a good preparation of hemp is incomparably the best drug for depressive mental conditions. Not even opium gives the same feeling of content and well-being, both physical and psychical, and in support of this view it is noteworthy that among the drug addicts of Egypt with experience of alcohol, hemp, and opium, hemp is preferred. There is also a likely use—again for a reliable preparation—in the practice of psychotherapy. Yawger[10] reminds us of J. S. Mill's observations on the powers of hemp to revive old memories and recall in detail things long forgotten. If hemp can thus make the unconscious mind more accessible, considerable developments in its use are likely to follow. Reference has already been made to its possibilities for the gynæcologist.

Sydenham's dictum "Nollem esse medicus sine opio" is much quoted; but opium, its alkaloids and their modifications are far from the pharmacologist's ideal, for all their value in the relief of pain and spasm. They fall short because of their tendency to addiction, their depressant action on respiration, their tendency to constipate, and the frequency of 'hang-over' next day. Hemp used medicinally escapes all these charges, even if it be rather less effective in relieving pain and spasm. Chemists and pharmacologists have long hunted for a drug with the actions of morphine and none of its disadvantages. A synthetic compound of the tetrahydrocannabinol type may prove, for many patients, to be this eagerly anticipated substitute.

[1] Walton, R. P., "Marihuana" (Lippincott, New York, 1938). Contributed by F. R. Gomila, 39.
[2] Sée, G., *Deutsch. Med. Wochenschr.*, **60**, 679 *et seq.* (1890).
[3] Aulde, J. *Therap. Gaz.*, **14**, 523 (1890).
[4] Walton, R. P. *et al.*, *J. Pharmacol. and Exp. Therap.*, **62**, 239 (1938).
[5] Gayer, H., *Arch. Exp. Path. u. Pharm.*, **129**, 312 (1928).
[6] Dixon, W. E., *Brit. Med. J.*, **2**, 1354, 1517 (1899).
[7] Dean, H., *Pharm. J.*, **87**, 160 (1911).
[8] Todd, A. R., NATURE, **146**, 829 (1940).
[9] Ludlow, R., "The Hasheesh Eater" (Harper, New York, 1857).
[10] Yawger, N. S., *Amer. J. Med. Sci.*, **185**, 351 (1932).

OBITUARIES

Prof. Henri Bergson

THE death on January 5 of Henri Louis Bergson marks not only the end of a brilliant chapter in French philosophy, but also the passing of one of the few philosophers of our time who can be said to have won international fame.

Bergson was born in Paris on October 18, 1859. His father was a Jew and a musician by profession, but his mother was English. During 1868–1878 he was a pupil at the Lycée Condorcet, where he excelled in classics, natural science and mathematics. Before entering the École Normale he hesitated between science and arts, but eventually decided on the latter. He graduated *agrégé de philosophie* in 1881. From 1881 until 1898 he taught successively in Angers, Clermont-Ferrand, at the Collège Rollin, and at the Lycée Henri IV. At the Sorbonne in 1889 he was awarded the Doctorat-ès-Lettres for his "Essai sur les Données immédiates de la Conscience" (the English translation of this work is called "Time and Free Will"), and in 1896 his "Matière et Mémoire" was published. He became *maître de conférences* at the École Normale in 1898. From 1900 until 1921 he was professor of philosophy at the Collège de France. In 1901 he was elected to the Institut de France and in 1918 to the Académie française. "L'Évolution créatrice" was published in 1907. For some time he was chairman of the committee of the League of Nations which was concerned with intellectual co-operation, and he was awarded the Nobel Prize for Literature in 1927. His last great work "Les deux Sources de la Morale et de la Religion" appeared in 1932.

According to Bergson, the essence of the universe is creative change working under the inspiration of the *élan vital*, the dynamical thrust behind the evolutionary process. We do not ordinarily apprehend the universe as thus constituted because the

activity of the intellect is 'cinematographical', always reflecting its ancient office as the servant of practice in the struggle for existence. Even in science intellection is not freed from its subservience to practical purposes, and the result is that the world is seen as made up of separate items loosely inter-related in a mechanical fashion. It substitutes succession for the continuity of real duration, taking, as it were, static snapshots of a continuous movement. Metaphysical intuition, however, which is instinct become self-conscious, affords knowledge of real time as distinct from discrete points in motion and separate moments in time. The immediacy of intuition is not the clear-cut focus of present consciousness; but is co-extensive with the wide range of possible experience and includes the whole past which "swells with the duration it accumulates" as it "gnaws into the future". Intuition is thus a sort of intellectual sympathy whereby the mind is transported into the objective flux at the heart of things.

Bergson employed the term 'space' to denote the form which characterizes the dead abstractions of the intellect as opposed to the pulsations of real duration. Spatiality belongs to all that is held to consist of mutually exclusive items externally related to one another. Hence, all spatiality necessarily involved in the linguistic expression of the living disclosures of intuition must be discounted, for such expressions are only aids to, and not substitutes for, the direct acquaintance of intuition itself. But Bergson did not hold that the intellect is *wholly* arbitrary in its excogitation of abstractions, for reality itself, being amenable to scientific classification, must contain a tendency towards the logical distinctness of spatiality. It is not saturated with duration so as to constitute an absolute creative synthesis. Like a fountain, reality has upward and downward trends, and both 'matter' and 'memory' are derivative abstractions.

This general conception had a liberating effect on the thought of the time. It emancipated the intellect from the narrow limits to which it had been restricted by the mechanically conceived natural science of the nineteenth century. It made plain the inadequacy of scientific mechanism as a metaphysic. But in our view it was unfortunate that Bergson himself continued to have a restricted view of intellection or reason, and represented it as a spatializing faculty. If this were really the case, one would think that there would be no sciences, but those of a geometrical character. In other words, what is required for the avoidance of narrow abstraction in philosophy is not a repudiation of reason, or its supplementation by another faculty, but a broadening of the traditionally 'rational' attitude to life so that it is contemplated in all its wealth of variety.

The restriction in question has, in fact, had lamentable consequences of which Bergson himself did not approve. Only those with a superficial understanding of his work could say that his philosophy sanctioned crude anti-rationalism. He never despised the intellectual disciplines or regarded intuition as a kind of short-cut to reality. This is clearly shown by his own methods of investigation. Thus, the "Essai" issued from a careful examination of the findings of experimental psychology. When preparing "Matter and Memory" he devoted five years to the study of the medical literature on aphasia. He believed that the discovery of the cerebral localization of the speech centres shed light on the ancient problem of the mind-body relation. Surely empirical science was never brought into closer relation with metaphysics! Again, he did not put forward his theory of creative evolution until he had acquired a thorough knowledge of the available biological evidence.

Bergson possessed great personal charm. Lucidity characterized both his writings and lectures. There was something of the poet in him and he was a master of the French language. During the years immediately preceding the War of 1914–18 his popularity was at its height, and fashionable audiences thronged his lecture-room. He was besieged with invitations to lecture in different parts of the world. As we would expect, the influence of his thought was widespread. Georges Sorel, the syndicalist, Marcel Proust, the man of letters, and Prof. E. Le Roy, the mathematician and liberal Catholic, were all, in spite of the great differences between them, profoundly influenced by Bergson's philosophy. There was something romantic about William James' professed conversion to Bergsonianism.

I met Bergson at his country residence near Tours in June 1939. He was then suffering from paralysis and unable to walk, but his mental faculties were alive. Undaunted by the rising tide of nationalism in Europe, he was still working for more effective international co-operation in intellectual matters. There was the threat of war and a sense of impending disaster in the air. But the aged philosopher was not despairing. He declared that it is generally through the travail of bitter experience that man rises to make his noblest achievements. ALEC BURKILL.

Prof. Robert Howden

THE death of Robert Howden, emeritus professor of anatomy in the University of Durham, on December 7, removes one of the great anatomists of the Edinburgh School and a figure noteworthy in the history of the University of Durham College of Medicine, Newcastle-upon-Tyne.

He was born at Braco in Perthshire in 1856 and after qualifying at Edinburgh in 1884 he became demonstrator in anatomy under Sir William Turner. At this time, the Edinburgh School was the source of the majority of candidates for the British chairs of anatomy, and in due course Howden crossed the border to take up an appointment in Newcastle. He was appointed lecturer in the College of Medicine in 1887 and four years later became the first professor of anatomy at Newcastle. He held this position until his retirement in 1927. His appointment coincided with the time when the rapid increase in the size of the School necessitated its removal from the small and inconvenient buildings in Orchard Street to the much more commodious premises in Northumberland

Road, which were to be the home of the College for fifty years and were only vacated in 1938.

Coming to the School when it was really taking on functions of vastly increased importance as a college in the modern use of the term, it is obvious that Howden must have found plenty of work to occupy his time and energy. He commenced with the development of his own department, and enriched it with many beautiful mounted specimens of his own dissection which replaced the old dried and varnished specimens previously in use. He also provided for the department a series of wall diagrams, many of them his own handiwork, which were a great adjunct to his teaching and some of which are in use to this day. Anyone familiar with the labour which this type of work entails will appreciate how much time he must have devoted to his department in these earlier days.

Howden's undoubted teaching ability soon expressed itself and contributed largely to the growth and success of the School at a crucial stage of its development. Those who knew him at this time recall the vigour and energy which he put into his work not only in the dissecting room, but also in his lectures and demonstrations. They recall, too, his great artistic ability on the blackboard and the care with which his lectures were illustrated by diagrams and beautifully dissected specimens.

During those early years in Newcastle, Howden was the only full-time member of the staff, and being thus always available in the building, management and administrative duties were loaded upon him, so that in due course he became secretary, dean of the Faculty of Medicine and registrar in addition to maintaining his professorial duties. It has been said by Grey Turner in his "History" of the College that Howden gradually became something of a dictator, but that he was a wise and considerate dictator. Anyone who was not associated with the College during this time of Howden's greatest activity may fail to appreciate the important part he played in the life of the College, or the way in which both staff and students came to rely upon his wisdom, his guidance and his sympathy. Through the generations of students who came under his care he exercised a profound influence on the medical profession in the north of England. He represented the University of Durham on the General Medical Council during 1918–28 and he was examiner in anatomy for the Universities of Edinburgh, Oxford, Cambridge, Liverpool and Birmingham and for the Conjoint Board of the Royal Colleges of Physicians and Surgeons.

Though so much occupied with administrative and teaching duties, Howden still found time to advance the study of his subject. Between the years 1886 and 1897 he made several communications to the Anatomical Society of Great Britain and Ireland, and in later years he continued his interest in the Society and was its president in 1914–16. He also edited nine successive editions of "Gray's Anatomy", and through this medium he spread his influence far beyond the confines of the School for which he worked. In his editorial work he maintained that meticulous attention to detail both in the text and in the illustrations which did so much to enhance the prestige of this text-book. He was also responsible for the section of "Cunningham's Anatomy" dealing with the special senses.

Howden was a kindly and generous man, polite and courteous; he was always helpful to his juniors and was never too busy to listen to their problems and to help by advice and encouragement, though he did not suffer fools gladly or tolerate slackness. He was a charming companion and found many friends in the pursuit of his favourite recreations, which included golf, fishing and curling. He is survived by his widow and leaves three sons and two daughters.

R. B. G.

NEWS has just reached us of the death recently in Prague of Dr. Duchoslav Panýrek, a well-known Czech medical scientist. He was the author of several widely read books of popular science and translated others from French, Russian and other languages into Czech. Dr. Panýrek took a prominent part in Slavonic medical and scientific congresses and had been awarded the Jugoslavian Order of St. Sava. He was seventy-three years of age.

The vice-president of the Czech Astronomical Society, Dr. Jaroslav Štych, also died in Prague early in January.

WE regret to announce the following deaths:

Dr. Alexander Bowman, formerly scientific superintendent, Scottish Fishery Board, on January 14, aged sixty-four.

Prof. B. P. Haigh, M.B.E., professor of applied mechanics in the Royal Naval College, Greenwich, on January 18, aged fifty-six.

Prof. H. S. Hele-Shaw, F.R.S., emeritus professor of engineering in the University of Liverpool, on January 30, aged eighty-six.

Sir William Horrocks, K.C.M.G., C.B., who was a member of the Mediterranean Fever Commission of the Royal Society (1904–5), and later director of hygiene at the War Office, aged eighty-one.

Mr. C. Thurstan Holland, a pioneer in the application of X-rays to medical and surgical work, on January 16, aged seventy-seven.

Sir John McFadyean, formerly principal of the Royal Veterinary College, on February 1, aged eighty-seven.

Mr. J. H. Silley, O.B.E., the well-known marine engineer, on January 24, aged sixty-eight.

Mr. A. J. Smith, chief laboratory assistant to the Marine Biological Association at Plymouth, on January 29, aged sixty-nine.

Sir Pendrill Varrier-Jones, founder and director of the Papworth Village Settlement, on January 30, aged fifty-seven.

Dr. G. E. Vincent, president of the University of Minnesota during 1911–17, and of the Rockefeller Foundation in New York during 1917–29, on February 1, aged seventy-six.

NEWS AND VIEWS

Awards of the Geological Society

THE following are the grounds for the awards of the Geological Society: Wollaston Medal to Dr. A. L. Day, for his researches in vulcanology and in the field of experimental petrology; Murchison Medal to Dr. Murray Macgregor, assistant director (Scotland) of the Geological Survey, for his work in Scottish geology and particularly the Carboniferous rocks; Lyell Medal to Mr. E. S. Pinfold, for his discoveries concerning the stratigraphy and structure of the oil-bearing regions of Burma and the North West Province of India; Bigsby Medal to Dr. C. J. Stubblefield, of the Geological Survey, for his work on the trilobites and on the stratigraphy and palæontology of the palæozoic rocks; Wollaston Fund to Dr. K. P. Oakley, of the British Museum (Natural History), for his work in palæontology and Pleistocene geology; Murchison Fund to Dr. J. Weir, of the University of Glasgow, for his researches in palæontology; a moiety of the Lyell Fund to Mr. W. Eltringham, of Crawcrook, for his work as a collector of fossil plants and arthropods from the Coal Measures; another moiety of the Lyell Fund to Dr. F. S. Wallis, deputy-director of the Bristol Museum, for his services to geology in Bristol.

Dr. Arthur L. Day

THE announcement by the Geological Society that the Wollaston Medal—its highest honour—has been awarded to Dr. Arthur L. Day, will give widespread pleasure. Dr. Day's name will always be associated with the Geophysical Laboratory of Washington, of which he was the distinguished director from its foundation in 1907 until his retirement thirty years later. In 1900, very early in his career, Dr. Day was called upon by the Geological Survey of the United States to equip a laboratory in which the exact methods of physical chemistry could be applied to the study of rock-forming minerals; and the following year, in collaboration with Dr. E. T. Allen, he began his famous investigation of the isomorphism and thermal properties of the felspars. This research may be said to have introduced a new era in mineralogy and petrology. It proved so successful that the Carnegie Institution of Washington decided to erect a special laboratory for the study and measurement with the utmost possible precision of the factors involved in the formation of rocks. Dr. Day, already commended for his resourcefulness, experimental skill and tireless energy, became its director.

The immense progress that has since been achieved by Dr. Day and his enthusiastic band of colleagues—attested by more than a thousand publications—proves the wisdom of that happy choice. The researches have included the investigation of a wide variety of mineral systems of one to five components; of the effects of volatile constituents; of the effects of temperature and pressure on minerals and rocks; of crystal structure; of the production of schistosity; of the gases and gas reactions of active volcanoes; of the nature and origin of hot springs and geysers; of many natural assemblages of rocks and their geochemistry; of the radioactivity of rocks; and of many economic problems such as those connected with the manufacture of cement and optical glass. In some of these Dr. Day has himself taken the leading part, especially in the adventurous study of volcanic phenomena. Latterly he became attracted to the hot-spring problem, and to the results of his work in this difficult field he devoted his address to the Geological Society of America, of which he was elected president in 1938. Dr. Day has always been outstanding for his remarkable flair for devising successful experimental methods and apparatus. His own deep passion for 'the rigour of the game' has established a tradition of high scientific accuracy which his colleagues have worthily upheld. Workers from many other countries have been trained in the famous Laboratory under his stimulating guidance and have returned to their home-lands to spread that tradition far and wide. Dr. Day's innumerable friends and admirers will feel that there could be no more appropriate recipient of the Wollaston Medal, awarded, as it is, to honour those who have made—in the words of the founder—"researches concerning the mineral structure of the earth".

Institution of Mining and Metallurgy: New President

MR. E. H. Clifford has been elected president of the Institution of Mining and Metallurgy for the year 1941–42, and will take office in May. Mr. Clifford, who was educated at St. Paul's School and received his technical training at the Royal School of Mines, London, and the Freiberg Bergakademie, began his mining career on the Witwatersrand in 1897, and worked continuously in South Africa until the War of 1914–18. He has managed various mines and in 1914 was appointed consulting engineer in Johannesburg to the Central Mining-Rand Mines Group. During the War, Mr. Clifford joined the Mineral Resources Department of the Ministry of Munitions, of which he became chief technical adviser, and at the end of hostilities resumed his former appointment with the Central Mining Group in South Africa, from which he resigned in 1922. In 1926 Mr. Clifford was appointed consulting mining engineer to the British South Africa Company, a position which he still holds. He was recently co-opted as a member of the Departmental Committee lately set up by the Ministry of Supply to inquire into the possible increased production of non-ferrous ores in the United Kingdom. He is also a member of the governing body of the Imperial College, to which he was appointed by the Royal Commissioners for the Exhibition of 1851.

Science Students at Universities and Schools

THE National Service (Armed Forces) Act is being applied to six new age groups covering the ages 18–19 and 37–40. The existing Schedule of Reserved Occupations is also to be revised, the tendency being to make reservation depend to an increasing extent upon the actual work being done by the man for whom reservation is sought, and not simply upon his age and registered occupation. In connexion with the registration of the 19-year-olds, arrangements are already in existence to safeguard the supply of men studying to obtain certain scientific and technical qualifications that will fit them for important national work. The University Joint Recruiting Boards have power to recommend the deferment of the calling-up of such men who are studying at universities or who are studying for a Higher National Certificate or a Higher National Diploma. These arrangements will be extended in future to young men engaged in particular scientific and technical studies who are still at school but will shortly be proceeding to universities, provided that they have obtained the Higher School Certificate or will shortly be sitting for that examination and show exceptional promise. Consideration is being given to the reservation of all medical and dental students irrespective of the stage they may have reached in their studies.

Red Locust Control Organization

THE Colonial Office announces that Mr. A. P. G. Michelmore has been appointed to the new post of locust officer in Northern Rhodesia. Mr. Michelmore, who has been serving with the Forces, has devoted some years to the study of the red locust, and in view of the importance of locust control he has been released for this work. The desirability of establishing control organizations in breeding areas of certain species of locusts was considered by the Fifth International Locust Conference held in Brussels in 1938, and eventually proposals for establishing these Control Organizations were put forward. In present circumstances, the red locust, the known breeding areas of which are in Northern Rhodesia and Southern Tanganyika, is the only species for which it is practicable to establish a control scheme. It is evident that the original international scope of the scheme must for the present be disregarded. The urgency of the scheme lies in the necessity for preventing, if that be possible, or at least reducing, the huge losses incurred annually by the cultivators of Africa through the depredations of locusts; at the present time, when people are more and more dependent on their own locally produced food supplies, the desirability of reducing the wastage by locusts is even more important than before.

Lord Lloyd, the Secretary of State for the Colonies, has therefore formulated under the Colonial Development and Welfare Act, 1940, a scheme for the establishment in Northern Rhodesia of a control organization, and a free grant of a sum not exceeding £3,000 has been made available to meet the capital cost. The scheme will be administered by the Government of Northern Rhodesia, but neighbouring Governments will contribute to its annual cost. The present swarming cycle of the red locust is still continuing, though there are indications that this cycle is declining, and breeding is gradually concentrating in the most favoured areas. There is, however, always the possibility that from the known permanent outbreak areas new swarms will emerge and reinforce those swarms of the present cycle which are dispersed. While it is not proposed that the new organization should undertake practical control in the temporary breeding areas, steps will be taken to organize observation in case such areas should develop into permanent breeding places, and investigations will be carried out into the natural conditions under which locusts breed, etc., in order that methods of prevention and control may be improved.

Flight Refuelling

IN a paper read on January 22 before the Royal Society of Arts, Sir Alan Cobham described experiments in flight refuelling that have been carried out for the last ten years. They culminated in the method used on the Empire flying boats which were operating the Atlantic experimental services. Sixteen crossings were made by the boats *Caribou* and *Cabot* between August 5 and October 1, 1939. In one of these, refuelling was unnecessary, as there was a very strong westerly wind that helped *Caribou* to complete the crossing with the original take-off load of fuel. These flights have proved that the method is successful, and the equipment adequate. Mechanization of some of the units would save time and labour during the operation, and suitable wireless equipment is necessary in order to ensure contact between the machines and the bases.

There is no special difficulty in using the apparatus at night, or in bad weather, as the connexion between the tanker (giver) and the air liner (receiver) is almost automatic. In fact it is claimed that flight refuelling can be carried out in any sort of weather in which air transport is possible. The general principle of the operation is that the tanker (giver) flies behind, above, and to one side of the receiving craft. The hose passes from the nose of the tanker to the tail end of the receiver's body. Thus the hose, or the contacting and hauling lines, pass over no part of either aircraft, and there is no danger of entanglement. Although refuelling after having taken off allows of an increase of 46,000–53,000 lb. weight, this by no means represents the extra load that could be carried upon an aircraft designed for the purpose. A machine of to-day, limited in loading by take-off conditions, can carry about 30–35 lb. per sq. ft. of wing area, whereas one designed for refuelling in the air, and therefore not so limited, could carry 50–60 lb. per sq. ft. in flight. The paper visualizes loadings of 80–90 lb. per sq. ft. as being practicable. Such aircraft should be capable of air ranges of 5,000 miles, and it becomes possible to link up all the important centres of the world by air lines operating at these distances between landings.

The Task of Civics

An appeal on civics, recently issued by the Parents Association, copies of which are obtainable from Miss Voigt, 37 Vine Lane, Hillingdon, Middlesex (5*d*., including postage), suggests that two of the most insistent problems confronting parents are how to win physical and political security for our children and for future generations, and how to teach our children to fight more successfully against the innate tendencies towards barbarism which recent history has revealed so clearly in the human mind, and thereby to achieve a civilization far more just, public-spirited and high-minded than ours has recently been. In regard to the first, the circular urges that it is our duty as parents to bring up a hardy race of children, trained and disciplined for defensive war until really reliable machinery has been created for making war impossible in future. In face of the tremendous external dangers which have always existed, though not fully realized, children should not be brought up to the rather soft and easy life which has been usual in western Europe in recent generations, since peace, no less than war, needs strength and discipline.

In regard to moral and spiritual security, many parents have failed to teach their families how to win moral and spiritual stability for themselves. However long the War lasts, and whatever our hardships, we must as parents at home train our young people in future more intelligently and thoroughly in the greater things of life, and inspire them so that they may become strong men and women of action, determined to fight to the uttermost against external enemies as well as against their own selfish nature. The strength, width of sympathy and higher values which we are achieving in this War must be preserved and developed in times of peace. To do this, it is suggested that just as the States of ancient Greece combined together in the fifth century B.C. to defeat the Persian barbarism and went on after victory to found a great civilization, so now we should seek to create with our children's help a new civilization, the greatest yet seen in history. This will involve not merely enduring the present War until the modern barbarian is defeated, but also training our children more carefully than ever so that they may be able to build up such a civilization after the War. It involves also an attempt to re-state the Christian aim so that it may seem to our children more intelligible, more practical and more in keeping with the whole of life. The programme calls for the allegiance of all parties and all classes, a high degree of strength and unselfishness and a determined effort to make our faith more real and to show our children how to find and keep their own faith.

Sir Astley Cooper

Sir Astley Panton Cooper, the centenary of whose death falls on February 12, was one of the most eminent surgeons and anatomists of the first half of the nineteenth century and a pioneer in experimental and vascular surgery. He was born at Brooke in Norfolk on August 23, 1768. His grandfather was a distinguished surgeon of Norwich and his uncle senior surgeon at Guy's Hospital. He was apprenticed to Henry Clive, surgeon to St. Thomas's Hospital, and after study at Guy's, St. Thomas's, Edinburgh and Paris, succeeded his uncle at Guy's in 1800. Two years later he was awarded the Copley Medal of the Royal Society for two communications on the effect of rupture of the membrana tympani, and was elected F.R.S., becoming a vice-president in 1830. His rise in the medical profession was remarkably rapid. In 1805 he was one of the founders of the Medical and Chirurgical Society, of which he became president in 1819, he was twice president of the Royal College of Surgeons of England (1827 and 1836), and in 1828 was appointed sergeant-surgeon to George IV and in 1830 to William IV.

The subjects of Sir Astley's principal works were the anatomy and surgical treatment of hernia, of which the first part appeared in 1804 and the second in 1807, dislocations and fractures of the joints (1822), diseases of the breast (1829), structure and diseases of the testis (1830), anatomy of the thymus (1832) and surgical essays in collaboration with Benjamin Travers (1840). His name has been attached to cystic tumour of the breast and to varieties of fasciæ, hernia and ligaments. He received numerous honours from British and foreign universities and learned societies, being member of the Institut de France, D.C.L. of Oxford, Edinburgh and Glasgow, and honorary member of learned societies of Germany, Russia, Italy and Mexico. His portrait by Sir Thomas Lawrence is in the Council Room of the Royal College of Surgeons, and his statue by Baily is in St. Paul's Cathedral; he was buried in the chapel of Guy's Hospital.

Tea-Growing in U.S.S.R.

It is reported in *Izvestia* that the crop of the U.S.S.R. in 1940 produced 23,500 tons of tea. The tea plantations in Georgia, where the bulk of the tea is grown, now occupy an area of 121,000 acres. An additional 7,500 acres will be planted to tea next spring. A certain amount of tea is also grown in Soviet Azerbaijan. Tea-growing was first introduced into Russia fifty-six years ago, at Chakva, near Batum (Georgia). An area of five acres was then planted to tea. The cultivation of tea in Russia made little progress until after the Revolution and the inception of the five-year plans.

Ovarian Follicular Hormones

Prof. E. A. Doisy informs us that in the preparation of the abstract of a paper of his under this title which was used in Nature of November 9, p. 624, a serious error was made. Prof. Carl Bachman, of the University of Pennsylvania, has made important contributions to endocrinology, but the synthesis of equilenin was accomplished by Prof. Werner E. Bachmann, of the University of Michigan. Actually Werner E. Bachmann did not synthesize theelin, but Marker had already shown that equilenin can be converted into theelin so, consequently, it was unnecessary for Bachmann to carry his work further than the synthesis of equilenin.

Earthquake in Cyprus

FURTHER news has been received of the earthquake recently reported to have taken place on January 20 in Cyprus (NATURE, February 1, p. 145). The epicentre of the earthquake appears from these latest reports to have been some five or six miles to the south of Famagusta. At Paralimmi, a village of 500 houses about 8 miles south of Famagusta, 50 houses were destroyed, 100 seriously damaged and four people were injured. Cracks and displacement of stones in large buildings and houses were widespread in the island, though no structure of importance collapsed. The Citadel, Mosque House, and Cathedral in Famagusta suffered damage, as also did Kyrenia Castle.

Other Recent Earthquakes

ON January 29 an earth tremor was experienced in Bucharest. It will be remembered that on November 10, 1940, a severe earthquake shook the city and the surrounding district, including the Rumanian oil field near Ploëşti (NATURE, November 23, p. 675; 1940). Also on the evening of January 29 a severe earth tremor lasting 10 seconds according to human perception shook parts of California. No damage or casualties are so far reported.

Distant earthquakes were recorded at Kew Observatory on January 20, 21, and 24. The first, received at 3h. 43m. 4s. G.M.T., may have occurred in Sicily. The first and second were recorded chiefly by the short-period instrument and the records were somewhat confused by microseisms.

The United States Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association has made a preliminary determination of the epicentre of the earthquake of November 23, 1940, at 3h. 48m. 52s. G.M.T. Seismographic reports were received from the observatories at Manila, Huancayo, Pasadena, Philadelphia, Fordham, Burlington, Buffalo, and Tacubaya. From these reports the epicentre appeared to be near latitude 9° N., longitude 84° W., which is in the Pacific Ocean just off the coast of southern Costa Rica between Port Violín and Port Mala (Central America). This is in a well-known seismic zone.

On January 27 at about 3.20 a.m. local time an earthquake occurred with epicentre some 85–90 miles from Bergen in Norway. It is reported to have been the severest and nearest the locality has ever had, though no further details are available.

Announcements

THE Council of the Institution of Electrical Engineers has elected the Right Hon. Sir Andrew Duncan to be an honorary member of the Institution. This distinction has been conferred upon Sir Andrew Duncan in appreciation of the outstanding services rendered by him to the electrical industry, particularly during his eight years of office as the first chairman of the Central Electricity Board. The Council has also made the nineteenth award of the Faraday Medal to Dr. A. P. M. Fleming, a past-president of the Institution. The Faraday Medal is awarded by the Council of the Institution not more frequently than once a year, either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science, without restriction as regards nationality, country of residence, or membership of the Institution.

THE Council of the Royal Society of Edinburgh has awarded the Gunning Victoria Jubilee Prize for the period 1936–40 to Sir James Irvine, principal of the University of St. Andrews, for his distinguished contributions to organic chemistry; and the Macdougall Brisbane Prize for the period 1938–40, to Dr. E. L. Ince, Mathematical Institute, University of Edinburgh, for his papers on "The Periodic Lamé Functions", published in the *Proceedings* of the Society within the period of the award.

THE triennial award of the Coopers Hill War Memorial Prize and Medal, which fell in 1940 to the Institution of Electrical Engineers, has been made by the Council to Mr. J. S. Forrest, for his paper on "The Characteristics and Performance in Service of High Voltage Porcelain Insulators".

PROF. JAKOB SEILER, professor of special zoology in the Swiss Federal Institute of Technology, Zurich, has been elected a member of the Leopold Caroline Academy of Natural Science at Halle.

PROF. S. CHAPMAN, professor of mathematics in the Imperial College of Science and Technology, will deliver the Kelvin Lecture of the Institution of Electrical Engineers on May 8; the subject of the lecture will be "Electrical Works by Helios, or the Sun and the Ionosphere". The council of the Institution has decided not to hold meetings of the Institution in London during the second half of the session. A list of some of the papers that would have been included has been issued and advance copies can be obtained from the secretary of the Institution.

THE following have been appointed officers of the Parliamentary and Scientific Committee for 1941: *President:* the Earl of Dudley; *Vice-Presidents:* Capt. S. F. Markham, M.P.; Viscount Samuel, Prof. A. V. Hill, F.R.S., M.P.; *Chairman:* Capt. L. F. Plugge, M.P.; *Hon. Secretary:* Dr. W. R. Wooldridge, National Veterinary Medical Association, Gordon Square, London, W.C.1; *Secretary:* Christopher Powell, Parliamentary and Scientific Committee, Courtfield House, 13 Courtfield Road, London, S.W.7.

ACCORDING to the official report (*Bol. Of. San. Panamer.*, **19**, 936; 1940) the provisional vital statistics for 1938 in the Argentine Republic are as follows: living births, 294,102; infantile mortality excluding the provinces of Santa Fé, Corrientes and Mendoza, 24,942; stillbirths, 9,188; population on December 31, 1938, 12,956,602; Federal Capital: births, 42,890; marriages, 21,046; deaths, 28,308; infantile mortality, 2,126; stillborn, 1,682; population, 2,345,221. In 1937, 288,161 living births were registered throughout the republic. The highest birth-rate was found in the provinces of Salta and the lowest in the Federal Capital and Province of Buenos Aires.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Relativity in the Remotest Heavens

THE study of pathology, not to mention heredity, has long been leading into the inconceivably small: now astronomers with their giant telescopes are leading us towards the infinitely great. The analysis of the statistics of the spiral nebulæ, remotest of things that we know, has recently been leading the Harvard astronomers (H. Shapley in *Proc. U.S. Nat. Acad.*) to conclusions that invite inferences. It appears that these objects, more numerous perhaps than all the visible stars, are distributed not uniformly, but rather as including humps or patches, and with complete extinction along our own Milky Way where alone the haze would absorb their light.

An earlier result, now conspicuous, is that these distant spirals are all receding, rather uniformly, with speed proportional to distance from the observer. Some significance must attach to this. Very brief reflection may indicate that it suggests a universe uniformly expanding, which has now become a familiar concept. For if K is the observer's own star, and S a distant star whose radial relative velocity he can measure by its spectrum, expansion uniform in all directions involves that the distance KS would be increasing proportionally to itself, so that any star whatever would be central (as already discussed by E. A. Milne), which is just the law of relative recession observed from the earth.

We are now, however, not likely to forget that all motion is relative, so that the recession of the nebulæ may be described as apparent, being relative to a uniformly shrinking spatial frame. Why then not make this remotest nebular system itself approximate to a 'fixed' ultimate foundation of the universe and convert the space into our selected convenient frame of reference, contracting through them by shrinkage? Since an absolute scale of time is the ultimate mental foundation from which schemes of spatial distribution are to be derived (cf. recent discussions by A. A. Robb) may we take this scale of time universal for all minds to be increasing—relative to itself as Euler would have said? We here contemplate the observer's space as shrinking inwards from infinity so that it is gradually absorbed, for it is only a frame and not material—unless indeed we eliminate the idea of motion altogether (an Einstein universe has been said to be static) and modify the quasi-aether which transmits universal radiation so that the velocity c, being the other factor in an ultimate ct, is increased gradually instead of the value of t.

It has been a main recent source of perplexity that the radial velocities of recession of the field of nebulæ, as observed, which *are* material objects, are so great that these bodies must have been huddled together in a time far too short for astronomical or even geological requirements. But if so—or alternatively if the effect is ascribed to increase in the other factor in ct of the product, the quasi-aethereal velocity c with which the radiation is transmitted—the trouble seems to disappear.

The velocities of the apparently expanding system of nebulæ need not be radial. For any motion without finite deformation of the system as a whole may be superposed: and we have thus to take into account such superposed proper motions in their relative free paths, which presumably become smoothed out into small local deviations after the manner of the local motions of the molecules in a gas. From these deviations in velocity a mean free path would be deducible. May it be taken that the distribution of the nebulæ somewhat in patches, as now revealed, indicates that there has not been time, since the original very abrupt condensation locally into rough aggregations, from the original chaos (for which dynamics has something substantial to say), to evolve the uniform free gaseous type of distribution within the permanent because rotating nebulæ? This order of ideas would tend to confirm our description as nebular aggregations, more or less a 'fixed' system spaced out sporadically by the primordial convulsion in a uniformly contracting frame of space, without upsetting our beliefs otherwise gained as to the duration of the universe. Note also, on the cognate topic of the profusion of double stars, that a binary aggregate possesses a great advantage over a multiple in its permanence: the latter usually either dissipates or falls away into a binary.

It is common form that individual atoms involve the unique absolute time, from which astronomers construct their personal times, through their spectral periods: on the basis of this supreme fact a claim can be made that one function of the atomic constitution of matter is to provide a connexion between the material universe of dead physical law and the cognizant pervading and controlling but unfathomed world of universal time braced by memory.

Finally, whence this character of universal spirality? It is dynamically plausible that systems not rotationally controlled would have dissipated on account of internal motions (thus in our own galaxy there are very few runaway stars), as they perhaps continue to shed off rough-hewn crystalline meteors hurtling through space with planetary velocities, which exhibit signs of having been involved in catastrophic origins, or else deriving from small comets shattered long ago by rapid heating.

More might be advanced, but our time is not appropriate for details. Except that one may note that the genesis, after the ideas of Kant and Laplace, of our own solar system may be saved if the notion here suggested is accepted, of the original very rapid dynamical aggregation of a diffused chaos into collocations, of which the rotation makes some permanent, and that these, which become more slowly smoothed out by internal interaction, possess, carried along within themselves, subsidiary rotating aggregates having their own subsidiary spiral character as gradually flattened by centrifugal and gravitational interaction, out of which independent planets such as Jupiter, and their satellite systems, conspicuously oblique to the plane of the solar system, may be

slowly evolved—these satellite systems being mainly attached be it noted to the more distant planets—while the whole aggregation with its subsidiary bodies is gradually smoothed out by the frictional interactions of the mutual attractions of its parts into the now permanent solar system as a whole. The arresting difficulty in the Laplacian scheme, which arises from a large proportion of the angular momentum of the solar system which belongs to the larger planets, would thus be evaded in perhaps a very natural manner.

In any case, it is plausible speculation superposed on factual description that gives interest to domains of abstract science.

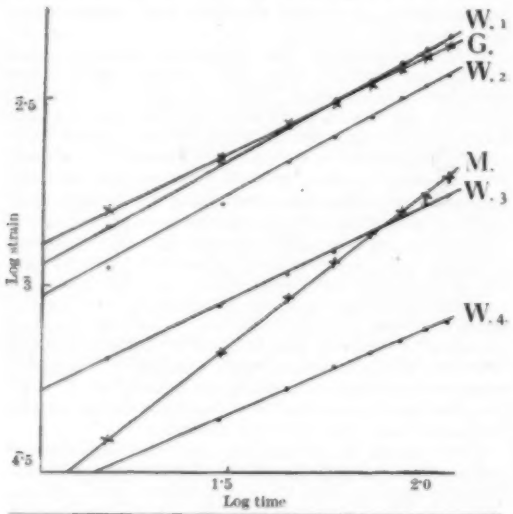
Holywood, Northern Ireland. Jan. 3.

JOSEPH LARMOR.

Rheology of Plastic Materials

WE have been particularly interested in the letter from Dr. Scott-Blair and Miss Coppen on the compression of cylinders of soft materials, published in NATURE of December 28, p. 840, as the treatment of compression test results by those workers appears to us to be of very wide application.

Considerable research has been carried out in our laboratories on the rheology of asphalts and bitumens, and in particular we have been working for some time on the extension and recovery of asphalt strips. These specimens, normally 30 cm. × 2·5 cm. × varying thicknesses ranging from 1·5 mm. to 6·0 mm., contain varying proportions of soluble bitumen ranging from about 14 to 80 per cent in conjunction with different fine mineral powders and sands.



	Material.	S dynes/cm.^{2}	K	Log ψ
W. 1.	Gunned Asphalt W.	$3{\cdot}37 \times 10^5$	0·56	9·03
W. 2.	do.	$2{\cdot}77 \times 10^5$	0·54	9·01
W. 3.	do.	$1{\cdot}57 \times 10^5$	0·49	8·96
W. 4.	do.	$0{\cdot}97 \times 10^5$	0·43	8·97
M.	Mastic Asphalt A.	$1{\cdot}31 \times 10^5$	0·78	9·44
G.	Gunned Asphalt G.	$2{\cdot}57 \times 10^5$	0·48	8·77

If the extension (and recovery) is plotted against time, curves are obtained which indicate that there is little or no immediate elastic extension on applying the load, or recovery on removing it, but the extension portion of the curve may be regarded as an elastic fore-effect on which is 'superimposed' an approximately linear viscous flow effect.

Similarly, the recovery portion of the curve is due to an elastic after-effect and is exponential in form. The most interesting point, however, is that if the results are treated according to the Scott-Blair procedure, and log strain plotted against log time, straight-line curves are obtained, and the equation $\psi = S\sigma^{1/k}t^k$ (where S is the shearing stress, σ is the strain, and t is the time) is found to hold for these extension experiments just as well as for Scott-Blair's compression work. Moreover, our work to date indicates that both ψ and k are substantially independent of S for our materials.

A few typical results are given in the accompanying graph and table. The shearing stress was taken as one third of the tensile stress. Further work is being carried out, and full details will be published elsewhere.

D. C. BROOME.
L. BILMES.

Limmer and Trinidad Lake Asphalt Co., Ltd.,
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London, S.W.6. Jan. 14.

Prevention of Stem-Break, Browning and Seedling Blight in the Flax Crop

FURTHER to the reference[1] made to the prevention of seed-borne diseases of flax by seed treatment, the completion of experimental work for 1940 has given the following results. Although the season was unsuitable for the spread of *Colletotrichum Lini* in the crop, seedling blight occurred quite commonly in braird grown from infected seed. It was almost completely eliminated by seed treatment with *RD.* 7846 (Imperial Chemical Industries, Ltd.), used at 5 oz. per bushel (56 lb.) of seed and by the short-wet method of seed treatment using Ceresan *U.* 564 (Bayer Products, Ltd.) as the fungicide. Proprietary organo-mercurial dusts of proved efficiency against Helminthosporium disease of oats exercised a very good measure of control when applied to the seed at the rate of 10 oz. per bushel of seed. These results were obtained from a series of thirteen experimental centres scattered throughout the country and using samples of seed with percentage infections with *C. Lini* varying between 18·2 and 35·7.

A very promising measure of control of stem-break and browning (*Polyspora Lini*) was also obtained by employing the same methods of seed treatment. For this work seed samples with percentage infections of *P. Lini* varying from 2·8 to 23·7 were used at five experimental centres. The seedling and stem-break phases of the disease were largely eliminated by treatment, while the onset of the browning phase was longer delayed in crops grown from treated seed than in the controls.

Scutching tests were made on the crops grown in an exhaustive series of replicated and randomized plots at the Agricultural Research Institute, Hillsborough. For the stem-break and browning trials a seed sample carrying 23·7 per cent infected seed was used, and here significant increases in fibre yield ranging from 30 to 60 per cent were obtained from crops where the seed had been submitted to one or other of the aforementioned treatments. In the case of the series of seedling blight trials the differences were not so marked; the season was not suitable for the spread of the disease beyond the seedling

phase. Even so, the scutching tests indicated increases in fibre yield of up to 30 per cent in crops grown from treated seed.

While it is hoped to make further experiments with these and other methods of seed treatment, it has been decided in the present emergency to treat all home-saved seed with *RD.* 7846 at the rate of 6 oz. per bushel, if equipment and materials can be made available. Apart from securing a very large measure of control of these and possibly other seed-borne diseases of the flax crop, such treatment, if carefully and regularly carried out, should materially assist in ensuring seed stocks from becoming heavily contaminated with seed-borne parasites.

RD. 7846, with tetramethylthiuram disulphide as its effective constituent, has so far produced no phytocidal effect in the crop. Seed grown in 1940 and treated immediately after cleaning in early October has maintained its power of germination unimpaired up to date; this indicates that treatment may be carried out three months prior to sowing without risk of impairing the germination of the seed. *RD.* 7846 is stated to be non-poisonous, and this claim has been substantiated in so far as no ill effects have been observed on the health of calves and pigeons fed for a considerable period with flax seed heavily dressed with the fungicide.

Ministry of Agriculture, N.I., Plant Disease Division, The Queen's University, Belfast. Jan. 6.

A. E. MUSKETT.
J. COLHOUN.

[1] Muskett, A. E., and Colhoun, J., NATURE, **146**, 32 (1940).

Weighing Living Marine Animals

GROWTH in marine animals is little understood and offers problems of paramount ecological importance. In the majority of cases, however, considerable difficulties are encountered, partly because of the paucity of material in some cases, and partly because of the difficulty of weighing the animals. To overcome these difficulties a method—the principle of which is given here—is being developed, and it is hoped that problems of growth will thereby be greatly facilitated. So far as I could ascertain its use for such purposes has not been recorded before.

Stated briefly, the method is as follows.

The animal is weighed in ordinary sea-water, the specific gravity S of which is determined. The specific gravity of the water is then slightly altered by the addition of a little distilled water or either sea-salt or concentrated sea-water, and the animal left for some time—long enough to establish a physico-chemical equilibrium between the animal's enclosed water and the outside—before it is weighed again. Its weight, which was w in normal sea-water, will consequently change to w_1. The specific gravity S_1 of the resulting water at the equilibrium point is also determined. The difference between the values of the two weights divided by the difference between the corresponding specific gravities gives the volume V of the animal minus the internal cavities in communication with the exterior and containing sea-water. Therefore:

$$V = \frac{w - w_1}{S_1 - S} \text{ or } V = \frac{\triangle w}{\triangle S}$$

and $W = w + VS = w_1 + VS_1$, etc.

W = weight of the animal in air excluding the water contained in internal cavities in communication with the exterior.

It is thus calculated that a change of 0·01 in the specific gravity of the water causes a change in weight-in-water of 0·1 gm. in an animal 10 c.c. and 0·5 gm. in an animal 50 c.c. in volume, etc.

It is therefore possible to determine the volume and weight-in-air of such animals, excluding the water they contain, by weighing in two samples of water of different but known specific gravities.

Best results are obtained when the specific gravity is changed more than once, and particularly when it is equally increased and decreased. Thus, after the animals are weighed in ordinary sea-water, the specific gravity of the water is raised by X by addition of sea-salt and the corresponding weights are determined. The specific gravity should then be lowered by X also, below the normal, by the addition of appropriate quantities of distilled water. This is in order to obviate any possible interferences due to the effect of the change in osmotic pressure on intra-cellular water.

This method is especially suitable for such animals as sponges, corals, alcyonarians, many other cœlenterates, polyzoans, sipunculids, molluscs, echinoderms and similar sluggish or sedentary animals, which possess large cavities in free communication with the outside. Active and free-swimming animals can also be treated in this way after being enclosed in a perforated tube or netting, previously weighed separately in the sea-water used.

The existence of a physico-chemical equilibrium between the internal and external water may be foretold from the morphology and physiology of these animals. In many of them a constant circulation of sea-water is maintained by ciliary movements or muscular contractions. In the latter case, the action may be rhythmic or occasional, a great bulk of water being inhaled by expansion and exhaled by contraction. Robertson[1] has recently established the identity of the perivisceral fluid of Echinus with that of the sea-water in which it lives. This is also almost undoubtedly the case in the majority of the animals mentioned above.

This method has several advantages over others in common use. Methods based on linear measurements are subject to grave criticism, particularly in contractile animals and those of irregular growth form. Weighing out of water is also inaccurate owing to the great variation in the amount of enclosed sea-water depending on the state of expansion or contraction, as well as the water adhering to the external surface. Taking the dry weight is not more accurate, as it is always difficult to get rid of the salts completely without considerably affecting the actual weight of the animals, either in the process of washing or by the growth of bacteria and otherwise during desiccation. The present method possesses none of these drawbacks, and, above all, it has the advantage that it does not involve the killing of the animals. Growth phenomena and effects on the weight of animals produced by various factors can, therefore, be followed in individual animals. By this are avoided the inconveniences of statistical methods where accuracy is approached only by immensely increasing the number of animals dealt with.

H. A. F. GOHAR.

Marine Biological Station, Fouad I University, Ghardaqa, Red Sea, Egypt. Oct. 25.

[1] Robertson, J. D., *J. Exp. Biol.*, **16**, 387 (1939).

Multiplicity of Pituitary Hormones

THE large number of pituitary (anterior as well as posterior lobe) hormones postulated has for some time caused uneasiness to workers in that field. The reasons for this seem to be mainly the following: (1) It appears inconceivable that an organ of the size of the pituitary gland which has in the anterior lobe three and in the case of the neural lobe only one type of cell which may be secretory should elaborate so many individual substances. In answer to this it can be said that neither size nor cytological differentiation of an organ or organism has so far been shown to limit the complexity of its chemical pattern. The number of substances present in or derived from liver cells or unicellular organisms serve as example. (2) It has been suggested that some or all of the supposedly existing hormones may be cleavage products of larger molecular compounds, that is, artefacts produced by the chemical and physical procedures used for their isolation. This concept seems originally to have been formed by J. J. Abel[1], who maintained that the secretion of the posterior pituitary lobe consisted of large molecules carrying all known post-pituitary activities. Riddle[2] and Collip[3] applied this concept to the secretion of the anterior pituitary lobe. Cameron[4] has recently endorsed their view. The experimental basis of Abel's theory has since been partly invalidated as it has been possible to separate the oxytocic and pressor-antidiuretic activities of posterior pituitary extracts by mild procedures (fractional adsorption, electrophoresis) which make an injury to an originally present large molecule unlikely.

Separation of certain anterior lobe factors by 'mild', non-chemical procedures like electrophoresis and fractional adsorption has also been reported. However, certain clinical and comparative physiological observations suggest rather that pituitary principles are not secreted singly but in groups. As Cameron has pointed out recently, tumours of the different anterior pituitary cells are associated with signs which suggest an abnormal secretion of well-defined and constant groups of anterior lobe factors. With the reservation that little is known about the specificity of the secretory stimulus, these clinical observations may be taken to mean that there is no abnormal production of a single pituitary activity. Similar conclusions evolve from observations which touch the fundamental concept of hormonal action, namely, that tissue reactions to hormones are apparently in large measure dependent on adaptation of the cellular protoplasm to pre-existing substances. Unless we accept this contention, which has been endorsed by recent experimental evidence[5], it would be difficult to explain why, for example, the lactogenic anterior pituitary hormone[6] and the oxytocic posterior pituitary hormone[7] are found in the glands of male animals. The distribution of the posterior pituitary 'water-balance' activity throughout the vertebrate series furnishes a similar example. It appears that comparatively large amounts of this factor are present in all classes of vertebrates[8]; but an action (temporary increase of body-water) has so far only been found in amphibians. It would be easier to understand its presence in the pituitary glands of those classes of vertebrates on which, to our present knowledge, it does not act if we assume that the water-balance activity constitutes one of several activities of a large molecule to each of which the tissues of any phyletic class must be specifically adapted if an effect is to be produced.

Such indirect evidence is clearly of very limited value. The question arises therefore how more direct experimental evidence for or against the multiplicity of the pituitary hormones could be obtained. Two ways may be suggested: (1) Is a physiological stimulus for the secretion of a pituitary principle which by chemical methods has been successfully isolated, invariably associated with the secretion of *all* activities produced by the same type of pituitary cell? For example, Gilman and Goodman[9] and others have shown that the urine of rats deprived of water contains abnormal amounts of an antidiuretic substance. The post-pituitary origin of this substance was strongly suggested by the observation that hypophysectomized animals failed to excrete it. It has been claimed, therefore, that dehydration constitutes the physiological stimulus for an increased secretion of the post-pituitary antidiuretic principle. A clear proof that the stimulus of dehydration leads to the excretion of larger amounts of oxytocic as well as the antidiuretic factor could be interpreted to mean that the oxytocic factor is by necessity secreted with the antidiuretic one because both are activities of the same large molecule. (2) Can it be shown that pituitary principles which have been successfully isolated *in vitro* are present in significantly different amounts in the gland and in body fluids *in vivo*? Several hints to that effect have already been published[10,11]. With the important reservation that the methods used for the estimation of the active principles should be known to be uninjurious to protein molecules, investigations of this nature seem to offer the most profitable approach to the problem of the multiplicity of the pituitary hormones.

The question whether the various types of anterior and posterior pituitary cells are able to secrete every activity singly, or whether their secretion consists of large molecules with multiple activity the action of which depends on the response of the effector tissues, would seem to be not only of theoretical but also of practical interest. It is easily conceivable that the same processes which lead to an artificial separation of a single factor produce a change in its pharmacological and therapeutic properties.

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(Beit Memorial Research Fellow.)

Department of Pharmacology,
Oxford.
Jan. 9.

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RESEARCH ITEMS

Divination on the Congo

THE ethnographical collections of the Second Swiss Expedition to Angola (1932–33), now in the Neuchâtel Museum, include a group of thirteen baskets used in divination by various peoples of Angola (Tyokwe, Mbundu, Nyemba, Ngangela), which have been examined and described by Théodore Delachaux (*Bull. Schweiz. Gesell. f. Anthrop. u. Ethnol.*, **16**, 1939–40). The contents of the baskets are for the most part numerous and varied in character. They fall into categories, of which some appear in most of the baskets, others are peculiar to individual diviners. Of those which appear generally, the most important are sculptured figures, representing men and women in various attitudes, animals, and common objects such as musical instruments, arms, etc. These objects have a common significance, however far removed from one another their places of origin. Some of them have undergone a process of evolution which would render them unrecognizable if it were not for the occurrence of figures showing the intermediate stages of development. Elsewhere in Africa the receptacle in which the divinatory 'bones' are carried appears to have no ritual significance; but in Angola its sacred or magical character is obvious. It was inaugurated by a ceremonial of human sacrifice—usually a relative or child of the diviner (*Tyokwe*)—or the sacrifice of a goat or cock (*Ngangela*). Even if the basket passes out of the possession of the original owner, the spirit of the sacrifice remains attached to it, and demands no more than an occasional small sacrifice to renew its force. Certain material parts of the person sacrificed enter into the manufacture of objects in the basket, for example, powder contained in an antelope's horn.

The Genus Gigantocypris

THE Ostracod genus Gigantocypris is possibly represented by two species, *G. agassizii* and *G. müllerí* and the generic name is well deserved, since the former may reach a length of 23 mm. and the latter 16 mm. L. Lüders in 1909 gave a general account of the anatomy of the former, dealing with some of the organs quite fully. R.R.S. *Discovery* obtained and fixed a number of excellent specimens of the latter species, and they have enabled H. Graham Cannon (Discovery Reports, **19**; 1940) to give a detailed and well-illustrated account of its entire anatomy and especially of the blood and nervous systems. Thus, the structure of the members of this group of Ostracods is now satisfactorily known, and the author regards them as having been evolved from a minute ancestor. The shell is almost spherical and only slightly streamlined, suggesting slow movement, and whereas in all other Ostracods the two valves of the shell are separable, in Gigantocypris they are fused save for a relatively short ventral slit. The large body almost fills the shell and is held in position by the adductor muscle, which has lost its original function of closing the valves. Not only is the entire animal large, but its nauplius eye is relatively enormous, and comes to occupy the whole of the region between the anterior limbs and the heart. The paired eyes are reduced to a small pair of sacs and the frontal organ to a small tubercle. So, too, has the heart enlarged, so that compared with that of a typical small form like Doloria it is about fifty times as large as would be expected. The giant fibre system, so well marked in Doloria, does not appear to be present in Gigantocypris. Internally the apodeme system is well developed.

Storage of Broccoli and Cauliflower

EXPERIMENTS carried out at the Ditton Laboratory, East Malling, by W. H. Smith (*J. Pom. and Hort. Sci.*, **18**, 287; 1940) have shown that broccoli and cauliflower are both capable of low-temperature storage for several weeks and behave similarly. At ordinary temperatures (50°–70° F.) the outer leaves wilt and turn yellow. The curd sometimes begins to grow or 'blow' and becomes spotted by moulds (broccoli) or affected by soft rot (cauliflower). Deterioration was retarded at low temperature, 32°–34° F. being found most effective. The leaves remained green for 4–5 weeks and moulds developed only after 3–5 weeks, compared with 9–11 days at ordinary temperature. High relative humidity in the storage atmosphere was essential to prevent excessive wilting of the leaves, but promoted mould growth if too high; 95 per cent was suitable. Reduction of the oxygen concentration to 10 per cent in the absence of carbon dioxide did not appreciably retard deterioration. A mixture of 10 per cent carbon dioxide, 11 per cent oxygen and 79 per cent nitrogen was found most effective. With this mixture at 32° F. a suitable variety was stored for 4–5 weeks and remained in a marketable condition for 3–4 days after removal from storage. In air at 32° F. the storage life was about three weeks.

Water Relations of Plant Cells

IN a recent paper T. Bennet-Clark and D. Bexon (*New Phytol.*, **39**, 337–361; 1940) present new evidence in support of the view, already suggested by the first author, that the classical theory of osmosis can no longer be accepted as a complete interpretation of the water relations in plant cells. The authors follow Mason and Phillis in attempting differentially to express from a pile of leaf disks the vacuolar and cytoplasmic saps. In some of the species used the vacuole contains anthocyanin, and the presence of this in the expressed juices is regarded as evidence that they are vacuolar in origin. If the pressure on the pile of leaves is increased slowly (increments of about 5 atm.) then the volume of sap extracted at the various pressures varies regularly with pressure up to a 'break' in the curve. Below this break, the sap is colourless Above the break the sap is coloured and of high osmotic pressure; this is regarded as due to the development of fissures in the cytoplasm. When the residue is killed by freezing, more sap can be extracted under low pressures and the osmotic pressure of these solutions, derived primarily from cytoplasm, is relatively high. Extrapolation of the volume/pressure curve back to the pressure axis gives the hydrostatic pressure at which sap just begins to be extracted, and this is found to resemble very closely and of osmotic pressure so low (sometimes 0·05 atm.) that it tends towards pure water in composition. the turgor pressure determined plasmolytically.

When, however, the pressure is increased quickly (increments of 100 atm. rapidly applied) the extracted sap is coloured and of moderately high osmotic pressure (for example, 8–12 atm.). Samples obtained from the residue after killing are colourless, or at least poor in anthocyanin, and have osmotic pressures of the order of 25 atm. The authors conclude that the former extraction (8–12 atm.) is vacuolar, and the latter cytoplasmic, in origin, though both may be contaminated. The hydrostatic pressure on the vacuole is compared with the osmotic pressure of the vacuolar sap thus obtained, and is found to be of a much higher order. It seems therefore clear that the osmotic pressure of the vacuole, coupled with the necessary protoplasmic membrane completely impermeable to solutes, is not the sole cause of the observed hydrostatic pressure. A general mechanism is suggested whereby the continuous diffusion of water into the vacuole, necessary to maintain the turgor pressure at a level higher than the osmotic pressure, is brought about.

Morphology of the Apple Fruit

L. H. MACDANIELS has presented a very clear discussion of this problem in Memoir 230 of Cornell University Agricultural Experimental Station, April 1940. The external flesh has been variously interpreted as a fleshy axis (receptacular) region or as a fleshy calyx or floral tube; the latter view was originally stated by Linnæus, but has been very generally replaced by the view that the fleshy cup is receptacular since the ontogenetical studies of Payer. Prof. MacDaniels states concisely the main arguments advanced in support of both views, and then decides definitely, mainly on the grounds of comparative anatomy, that the five carpels have developed into a core with an external fleshy exocarp fused with the fleshy floral cup without, so that this fused cup is regarded as built up of fused floral appendages. The axis in this view is confined to the narrow median tract at the base of the core up to a region where are found small residual vascular strands after the ventral carpellary strands have been differentiated. In *Malus coronaria* and some other crab apples the line of function between ovary and adnate floral tube is marked by an aggregate of stone cells; in some apple varieties, for example, Orenco and Red Sauce, the flesh of the fruits is tinged with red except the ovary tissues, the line of demarcation is then very sharp and distinct.

The Deepest Boring

IT is not generally known that in March 1938, a boring for oil in the San Joachim Valley, California, was completed by the Continental Oil Company when it had attained a depth of nearly three miles. An interesting account of this enterprise has been given by C. B. Travis (*Proc. Liverpool Geol. Soc.*, **18**, 19–21; 1940). The first drilling, made in November 1936, was abandoned as a failure at 9,300 ft., but satisfactory evidence of oil encouraged the drilling of a second boring close by. This proved successful in yield and reached the unprecedented depth of 15,004 ft., being 1,794 ft. deeper than a boring put down in Louisiana at about the same time. Beginning in Recent sands overlying the Pleistocene, oil-shows were recorded at 7,120 ft. (Pliocene), at 12,715 ft. (Middle Miocene) and at 14,250 ft. (Oligocene), but the most productive horizons were encountered in the Middle Miocene at 13,092–13,150 ft. and again at 13,281–13,400 ft. The Eocene was penetrated for 37 ft. but proved unproductive. Some idea of the temperature gradient in this region is afforded by determinations of temperature ranging from 236° F. at 11,000 ft. to 268° F. at 15,000 ft.

International Comparison of Colour-Temperature Scales

MEASUREMENTS of stellar colour temperatures made in various countries, though in good relative agreement, show disquieting discrepancies when absolute values are compared. Since these latter depend in practice on the temperatures adopted for standard tungsten lamps, with the radiation of which the stellar radiation is compared, it has recently become desirable to make an international comparison between the various scales of colour temperature. Dr. R. C. Williams, of the Ann Arbor Observatory, spent the summer of 1939 in Europe carrying out this programme. The colour temperature of his standard lamp was measured in the United States, Holland, Great Britain, Germany, and France; and the spectral transmission of his filter-and-lens combination (used to raise the colour temperature of his lamp radiation to a value comparable with that of a hot star) was determined in the first three countries. The results (*Publ. Obs. Univ. Michigan*, **8**, 37; 1940) show quite clearly that the international disagreement cannot be due to systematic differences among the temperature scales of the standardizing laboratories. There is a range of only 6° C. (from 2,808° K. to 2,814° K.) in the determinations of the lamp temperature from the laboratories on the work of which scales of stellar colour temperatures have been based. This would result in a range of only 200° C. (from 13,800° K. to 14,000° K.) for the Ann Arbor zero-point of stellar colour temperatures; whereas the actual range to be accounted for is some twenty times greater than this. The agreement between the standardizing laboratories is the more convincing in that visual, pyrometric and spectrophotometric comparisons are involved. It seems that the technique of the astronomer is responsible for the disagreement.

Zeta Aurigæ

PHOTOMETRIC observations of the 1939–40 eclipse of the eclipsing variable star ζ Aurigæ, so far from elucidating further the structure of this remarkable binary, seem to have made confusion worse confounded. W. H. Christie (*Astrophys. J.*, **92**, 392; 1940) has combined observations from stations all over the world into a well-determined light-curve showing the partial phase, lasting 1·35 days, during which the *B* star is eclipsed by its giant *K* companion. Egress, 40 days later, was unfortunately accompanied by bad observing conditions almost everywhere. The observations during ingress disagree entirely with the previous conception (*Harvard Circular*, No. 417; 1936) of the *B* component as sinking into obscurity behind the *K* star as a planet sets in a smoky atmosphere, disappearing before it reaches the horizon. The curve actually found can best be represented on the assumption that the *B* star is not darkened at the limb and that it is occulted by the limb of the *K* star as if by a straight-edge. The observations indicate that general absorption of the light of the *B* star by the atmosphere of the *K* component must be negligible at heights greater than a few tens of thousands of kilometres. It seems that astrophysicists must wait another two years for the next eclipse in order to resolve this puzzling contradiction.

CONTROL OF PLANT VIRUS DISEASES BY CULTURAL METHODS

By IRESON W. SELMAN

CHESHUNT EXPERIMENTAL AND RESEARCH STATION

AT the Cheshunt Research Station, a study is being made of the interaction of environmental factors on the virus diseases of glasshouse crops, in the light of recent physiological work considered in conjunction with the empirical cultural methods practised by commercial growers. In tomato culture,

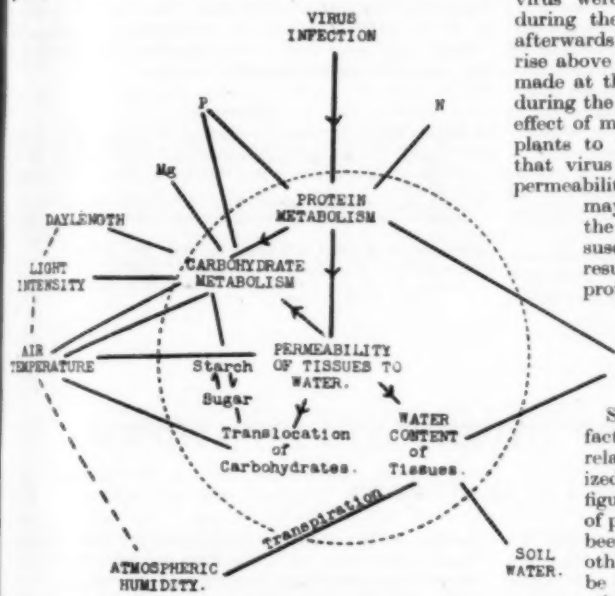

DIAGRAM TO SHOW THE INTERACTION OF VIRUS INFECTION AND ENVIRONMENTAL FACTORS UPON THE PLANT.

the 'growing out' of a virus disease is frequently practised by horticulturists when the accepted methods for control, such as roguing and the exercise of hygienic measures, have become impracticable because of widespread infection in crop plants too large to make replacement an economic proposition.

A review of earlier work, particularly in the study of potato 'degeneration' diseases, shows that many workers considered that the environment was all-important in determining the virulence of the disorder. Even when the presence of a virus had been conclusively demonstrated, Merkenschlager *et al.*[1] and Wartenberg *et al.*[2] sought to show that unbalanced metabolism, resulting from faulty mineral nutrition and/or climatic factors, was as important as virus infection in determining the vigour of potato stocks. It was, however, suggested[1d] that further study might permit reconciliation of the opposing disease infection and unbalanced metabolism theories of potato 'degeneration'. Work on the virus diseases of the tomato has indicated that such reconciliation can, in fact, be made.

Most workers agree that virus infection of a plant results in changes in the normal protein and carbohydrate metabolism and in the water content of the tissues. Ainsworth and Selman[3] showed that the percentage water contents of the stem, leaf and root of tomato seedlings infected with tobacco mosaic virus were lower than those of healthy controls during the early stages of the disease, but that afterwards the water content of the tissues tended to rise above that of the controls. Later observations made at this Station, on the wilting of crop plants during the early stages of virus infection and on the effect of mineral deficiencies on the reaction of crop plants to virus, have strengthened the hypothesis that virus infection initially tends to increase the permeability of the tissues to water loss, and later may tend to decrease it. The permeability of the cells to water probably also becomes more susceptible to environmental changes as a result of the incorporation of the abnormal protein molecules of the virus into the protoplasmic membranes. As a working hypothesis, virus-induced permeability changes do appear to conform to the facts so far observed in the tomato plant.

Some of the more important environmental factors and their effects upon the plant in relation to virus infection have been summarized diagrammatically in the accompanying figure. Only those factors which appear to be of primary importance in tomato culture have been included: it is recognized that many other environmental and internal factors will be involved in such a scheme, and the interrelations of the mineral elements, for example, in their effects upon plant metabolism, would make the scheme as complex in structure as the living plant itself. In addition to the relationships traced on the diagram, the importance of temperature, light and mineral solutes in their direct effects upon the permeability of the protoplasm must not be overlooked.

In relation to such a scheme, virus infection becomes, in effect, akin to the external environmental factors, being capable of inducing changes within the plant which can, to a large extent, be counterbalanced by the judicious control of the other environmental factors. In point of fact, commercial tomato growers have for many years tended to counteract mosaic and streak infections by the careful control of watering, temperature, ventilation and by the application of potash or nitrogenous fertilizers according to local conditions. The skilled grower is able to assess the requisite conditions for checking any undesirable growth or lack of vigour brought about by virus infection, from a knowledge of the past history of the plants and their present appearance.

When advising upon the treatment of virus-infected plants too large for roguing, it has been found most helpful to assume that an environmental

factor is at fault, in conjunction with the disease itself. Where a visit to a nursery is impracticable, a few rapid soil tests, made by a modification of Morgan's method[4], frequently reveal a relative deficiency of some essential element which is accentuating the metabolic effects induced by the virus, and a crop can often be saved from complete failure by proper cultural treatment. This procedure has been successful in many cases, but the difficulties of investigating all the local conditions at first hand sometimes restrict the complete elucidation of a problem.

Tompkins[5], working on the effect of environment on potato mosaic symptoms, showed that humidity, soil-temperature, light intensity and nitrogen, potash or phosphate deficiency, when investigated singly, had no effect in masking potato mosaic symptoms, and air temperature was stated to be "the main and only factor affecting the amount and intensity of symptoms in potato foliage under greenhouse conditions". This result is not surprising, since under the conditions of his experiments no single factor, other than air temperature, would be likely to exert such a profound effect both upon the permeability of the cell membranes and upon the general metabolism of the whole plant, as to affect materially all the metabolic changes brought about by the presence of the virus disease.

The severity and extent of tomato mosaic on commercial nurseries was stated by Bewley and Corbett[6a] to be increased by the presence of a high water table. The same workers found that plants severely attacked with 'stripe' could be induced to grow away from the disease and develop new top growth "either by suitable applications of sulphate of potash or by increasing the temperature"[6b]. Applications of potash (in the presence of lime) or raising the temperature of a glasshouse is likely to reduce the water content of a plant or "harden" it. On the other hand, many growers find that nitrogenous fertilizers, which tend to increase the water content of the plant or "soften" it, assist their plants to grow away from a virus disease. Consideration of the scheme outlined above will make clear that these results are not necessarily contradictory, but merely confirm the view that any cultural remedy for the treatment of infected plants is bound to depend upon the relative levels of the chief environmental factors.

Work is in progress to determine the extent to which the losses from virus diseases may be reduced by appropriate treatments.

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THE PROBLEM OF HYPERTOXIC DIPHTHERIA

By Dr. G. F. Petrie

A SEVERE form of diphtheria, characterized by a high degree of toxæmia and with an apparently haphazard distribution in time and place, has been prevalent during the past fifteen years in Great Britain and in other European countries. The toxæmia in patients with this form of the disease has seemed to be resistant to the curative action of diphtheria antitoxin.

About ten years ago a promising attack was made on this difficult problem when workers in Leeds[1] found that strains of the diphtheria bacillus, when cultivated from the throat of patients with an acute attack of the disease, can be classified into three types, to which they applied the terms *gravis*, *intermedius*, and *mitis*. The two first types, and especially the *gravis* type, are associated with the hypertoxic form of diphtheria, whereas the *mitis* strain is mostly found in the throat of mild cases. It is natural to think that the ability of each of these types to produce toxin in a culture-medium by well-known laboratory methods may be correlated with its lethal power, and that, therefore, *gravis* strains produce the most powerful toxins. Actually the opposite is true, for the strain which has been used for many years in antitoxin laboratories all over the world—the Park-Williams strain No. 8, so-called from the workers who introduced it—is not a *gravis* strain, and yet in a suitable fluid medium it furnishes a culture which, when freed from the bacterial bodies by filtration, is highly toxic for the guinea pig. Researches into the causation of hypertoxic diphtheria are of special interest at the present time, when public health authorities are fully aware of the risk of extension of epidemic diseases in children, including diphtheria, from abnormal circumstances brought about by the War; and thus a recent paper by R. A. Q. O'Meara on the subject, which gives an account of experimental work with far-reaching implications, deserves notice[2].

The author points out that the characteristic œdematous swellings that give rise in children with severe diphtheria to the so-called 'bull neck' are not seen in guinea pigs that have been inoculated subcutaneously with a lethal dose of the *P.W.* 8 toxin. When, however, he injected into a guinea pig a mixture of a suitable sublethal dose of this toxin and of a bacteria-free saline extract of a *gravis* culture grown on a coagulated serum medium, a huge œdematous swelling resulted; the saline extract alone was only slightly toxic and did not produce œdema.

Another striking experimental result may be mentioned. A characteristic complication of a diphtheritic infection in children which is not infrequently observed from two to seven weeks after the onset is muscular weakness or paralysis in various parts of the body, for example, the soft palate. Paralytic symptoms are often noted in guinea pigs

from two to four weeks after the administration of a dose of a slightly under-neutralized toxin-antitoxin mixture. A sublethal dose of a freshly prepared toxin or of the saline extract described by the author does not produce paralysis in the guinea pig, but a mixture of the two products which permits the survival of the animal for three or four weeks apparently gives rise with constancy to paralytic symptoms.

Evidence is brought forward by the author that certain complex relations between diphtheria toxin and antitoxin when mixtures of them are injected into guinea pigs can be explained on the assumptions: (1) that diphtheria toxins consist of varying proportions of substance *A* (the toxic component which is characteristic of the *P.W.* 8 strain) and of substance *B* (the active constituent of the saline extract); and (2) the formation of an antibody to each of these substances.

The author suggests that substance *B* is of the nature of a diffusing factor, that is, an agent which can be shown experimentally to increase the permeability of the connective tissues to fluids injected into them. He regards as a reasonable hypothesis that the diffusing factor is an integral part of diphtheria toxin, and that, indeed, toxins with similar physical characteristics that are formed by other bacteria consist, in general, of at least two factors, one of which actively promotes the absorption of the others by increasing the permeability of the tissues. An account of biochemical work on the diffusing substance and its probable relationship to mucinase is given in short articles that have recently appeared[3].

The author indicates the possibility that his results may be applicable to the prophylaxis of diphtheria by modifying the specific products which induce an active immunity to the disease; the immunizing agents now in use are derived from the toxin of the *P.W.* 8 strain, and are therefore deficient in substance *B*.

These observations and the inferences drawn from them are regarded by the author as providing the key to a number of difficult problems in the clinical and experimental study of diphtheria. For this reason serologists in laboratories elsewhere will doubtless repeat the work in order to test its validity. The details of results which may have been obtained from therapeutic trials in children with antitoxic sera that have been prepared in accordance with the author's views will be awaited with particular interest.

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CONFERENCE ON INDUSTRIAL RADIOGRAPHY

A CONFERENCE on Industrial Radiography organized by the Institute of Physics was held on January 25 in the library of the Research Laboratories of the General Electric Company, by the courtesy of the director, Dr. C. C. Paterson. Dr. V. E. Pullin, radiological consultant to the Aeronautical Inspection Department, was in the chair. The Conference was very well attended; members were present from all parts of Great Britain. They represented the many diverse industries which are now making considerable use of this comparatively new method of engineering inspection and development.

The proceedings opened with some introductory observations by the chairman, who emphasized the rapidly growing importance and value of this particular branch of applied science and the great practical advantages which must follow a general discussion of the subject such as the present meeting promised.

The first paper, on the "Application of Radiography to the Electrical Industry", was read by Mr. H. P. Rooksby and Miss K. L. Jackman, both of the Research Department of the General Electric Company. After outlining the general principles and technique underlying the work, the authors described, by the aid of many beautiful radiographs, a number of very interesting applications of this method of investigation. Considerable use has been made of the special technique known as planar radiography, which has already proved of great value in the medical radiographic field. This method has unique advantages where it is desirable to investigate any particular plane of the subject under examination. One of the most interesting applications illustrated by the authors was concerned with the radiography of large water- and air-cooled anode valves. Ordinarily it is an extremely difficult matter to check the final assembly of such apparatus as this, where many critical components are hidden. Even by radiography, the technique is extremely difficult, and very great credit is due to the authors for the beautiful results they have obtained. By means of these pictures the whole electrode assembly can be examined at any stage during manufacture or in the subsequent life of the valve.

The authors stated that in many instances every single valve is subjected to radiographic examination before acceptance. By a method of composite radiography it is possible to deal with valves as much as four feet in height.

Another interesting example is the use of X-rays in detecting defects in the cores of arc-lamp carbons. Radiography is used to determine the uniformity in thickness of the glass walls of cathode ray tubes. Radiography by means of the gamma rays of radium is also extensively used by the authors, who have found many useful applications for the method where X-rays are contra-indicated for one reason or another.

In the second paper, Mr. W. L. Harper, of the Aeronautical Inspection Department, Ministry of Aircraft Production, described in some detail the methods adopted in the radiological examination of the light alloy castings used in aircraft construction. The author pointed out that he is principally concerned

with inspection processes, and remarked that radiological examination is now compulsory in the case of certain important components of aircraft. Many thousands of light alloy castings are inspected by radiological methods every week.

Mr. Harper laid down certain rules which should govern the radiography of light alloys, and explained how radiographic technique has to be modified to yield the best results in different types of alloys. In some cases, fluoroscopic methods are used in the examination of certain castings, and the author remarked on the importance of suitable apparatus for this purpose, which must embody maximum sensitivity with complete safety for the operator; in this connexion, it was pointed out that the fluorescent screen should never be viewed directly but indirectly by means of an inclined mirror. A very large number of firms throughout Great Britain have now installed X-ray equipment and employ trained radiological operators in this work. He contrasted this state of affairs with that obtaining but a few years ago, when the radiological method was yet in its infancy and its potentialities were largely unrecognized.

In the very encouraging and stimulating third paper, Dr. L. Mullins, of the Research Department of Messrs. Kodak, Ltd., described some of the latest research work carried out in the Kodak Research Laboratories on the photographic materials specially adapted to the needs of industrial and engineering, as apart from medical, radiology. Dr. Mullins first dealt with these specialized requirements and explained how particular emulsions are being devised to meet the needs of the radiologist specializing either in heavy engineering work, or in the examination of light alloys and built-up articles, also in the realm of crystal analysis. He went on to explain some of the technical difficulties inherent in this highly differentiated research, and to describe the methods that are being developed to overcome them. In the final section of his paper he dealt with the general question of processing, and was able to give the meeting some useful advice on this highly important aspect of the work.

To most of those present, it was very gratifying indeed to know that the question of photographic research directed to the particular problems of industrial radiology is being so intensively studied. This development was evident from the comprehensive and careful outline which was presented by Dr. Mullins.

Mr. E. J. Tunnicliffe showed a slide of a piece of apparatus designed by him to facilitate the continuous movement of a specimen under fluoroscopic X-ray examination. A sphere of aluminium, which contains the specimen, is made to rotate in any desired manner in a beam of X-rays; the fluoroscopic image is thrown on to an inclined mirror and is observed in perfect safety by the operator. The whole operation is one of remote control and combines perfect safety with a high degree of sensitivity and efficiency.

The papers provoked a lively discussion in which the authors were kept busy in answering a diversity of questions. It was evident that the Conference had achieved its object in affording practical help to those engaged on this work and, at the same time, many questions were raised that will undoubtedly stimulate further research and experiment.

V. E. P.

FORTHCOMING EVENTS

[*Meeting marked with an asterisk is open to the public.*]

Monday, February 10

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 3 p.m.—Prof. F. Debenham: "A Laboratory for Physical Geography".

Tuesday, February 11

ILLUMINATING ENGINEERING SOCIETY (at the E.L.M.A. Lighting Service Bureau, 2 Savoy Hill, London, W.C.2), at 2.30 p.m.—Mr. J. G. Holmes: "The Recognition of Coloured Light Signals".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Prof. G. I. Finch, F.R.S.: "Explosives".*

WARBURG INSTITUTE (at the Imperial Institute Buildings, South Kensington, London, S.W.7), at 2.30 p.m.—Dr. F. Saxl: "Mithras—The History of an Indo-European Divinity".

Wednesday, February 12

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. G. V. Jacks: "Humus and the Farmer".

PHYSICAL SOCIETY (COLOUR GROUP) (at the Polytechnic, Regent Street, London, W.1), at 2.0 p.m.—Four Papers on "Colour Tolerance" (1, "Introductory"; 2, "The Commercial Aspect"; 3, "The Technical Aspect"; 4, "The Physical Aspect").

Thursday, February 13

ROYAL COLLEGE OF SURGEONS OF ENGLAND (at the Royal Society of Medicine, 1 Wimpole Street, London, W.1), at 2.30 p.m.—Prof. A. H. Burgess: The Hunterian Oration.

Friday, February 14

ASSOCIATION OF APPLIED BIOLOGISTS (in the Congregational Hall, Victoria Road, Harpenden), at 12 noon.—Annual General Meeting. 12.30 p.m.—Dr. J. Macleod: "Recent Work on the Sheep Tick and its Bearing on Control Measures". 2.15 p.m.—Dr. R. P. Hobson: "Recent Work on the Sheep Maggot Problem"; Dr. I. Thomas: "Some Practical Aspects of the Sheep Blowfly Problem".

ROYAL SOCIETY OF ARTS (INDIA AND BURMA SECTION) (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Diwan Bahadur S. E. Runganadhan: "Research Work in Indian Universities".

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in the Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—Mr. Leslie T. Morton: "Ships' Cargo-Handling Gear".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER IN ELECTRICAL ENGINEERING at the Constantine Technical College—The Director of Education, Education Offices, Woodlands Road, Middlesbrough (February 15).

ASSISTANT LECTURER IN THE DEPARTMENT OF MATHEMATICS—The Principal, Technical College, Huddersfield (February 20).

DEMONSTRATOR IN THE DEPARTMENT OF PHYSIOLOGY—The Secretary, Bedford College for Women, Regent's Park, London, N.W. (February 22).

HEADMASTER OF THE KING'S SCHOOL, ELY—The Bursar, The King's School, Ely, Cambs. (March 1).

CHIEF EDUCATION OFFICER to the Portsmouth Education Committee—The Chief Clerk, Education Offices, Northern Secondary School, Mayfield Road, North End, Portsmouth (March 3).

LECTURER AND/OR INSTRUCTOR IN RADIO ENGINEERING AND SERVICING—The Director of Education, The Polytechnic, 309 Regent Street, London, W.1.

EDUCATION OFFICER—The Acting Secretary, Educational Advisory Board of the British Social Hygiene Council, Tavistock House South, Tavistock Square, London, W.C.1.

ELECTRICAL ENGINEER for the Public Works Department of the Government of Nigeria—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9422).